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Protection of Iron and Steel

J. W. Gibbons, of the Santa Fe, who served as chairman of the test committee of the Master Car and Locomotive Painters' Association during the past year, and who was recently elected second vice-president of that association, contributes an article in this issue on the protection of iron and steel, which is of more than ordinary interest. The report of the test committee, which was abstracted in our October issue, page 539, attracted wide attention, as a result of which a number of inquiries were sent to Mr. Gibbons by master painters and other railway officers. Prompted by these requests Mr. Gibbons has prepared an article covering the technical as well as the practical side of the question. Deductions which may be drawn from the tests are clearly outlined; the article itself is brief and to the point and is not too technical for the busy practical man.

Railroads Have Started Buying

On another page we publish an item showing that the railroads of the United States placed orders during the month of October for 280 locomotives, 21,339 freight cars and 16 passenger cars. These figures are taken largely from the Railway Age Gazette, and a perusal of the equipment and supplies columns in the general news pages of recent issues of that paper develops some very interesting facts. In the week ended October 22 it reported orders for no less than 90 locomotives, 6,800 freight cars and 14 passenger cars, this making that week the best thus far this year, with the exception of the third week in May, when the Pennsylvania placed its order for 50 locomotives and 16,145 cars. But the third week in October played a "poor second fiddle" to the last week in the month, for in the issue of October 29 the Gazette was able to report orders for 177 locomotives and over 13,000 freight cars. October is always a good time of the year for the equipment companies, but times are rare when contracts are let for approximately $8,000,000 for locomotives, $240,000 for passenger cars and $20,000,000 for freight cars, a total of $28,240,000 for new equipment in a period of from 10 to 14 days. The orders for locomotives for domestic service reported to October 29 this year already total over 1,000, as compared with 848 reported to the end of October last year. Domestic orders for freight cars are also ahead of the figures for the first 10 months

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of 1914, the orders this year totaling approximately 72,000, as compared with 67,820 to October 30, 1914. If we add the 400 locomotives and over 13,000 freight cars ordered by the Russian Government of firms in the United States and Canada, we find that the totals to October 29, 1915, are already 1,400 locomotives and 85,000 cars, with two of the best months of the year to run. The total orders for locomotives and freight cars reported by the Railway Age Gazette for the entire year 1914 were but 1,265 and 80,264 respectively.

A Unique Competition

The competitions which we have announced in recent months have met with such hearty response on the part of our readers that we are encouraged to try out a rather unique scheme with the hope of receiving an even greater response. Many officers and foremen who have tried to improve the efficiency of their organizations or departments have adopted simple little schemes to inspire their men to do better and more efficient work. For instance, a master mechanic equipped a spare room next to his general foreman's office with a long table, having in it a drawer for each of the foremen. The foremen had been in the habit of keeping their papers and lunches at different places in the shop, but this brought them all together about the big table at the lunch hour. The effect in securing better co-operation and teamwork was almost immediate. There are hundreds of simple schemes of this sort that have given good results. We will give $10 each for the best three letters, from a practical standpoint, which are received on or before January 1, 1916, describing methods which have been tried out and have helped to "Tone up an Organization." The letters must not exceed 700 words in length. Those that are not awarded a prize, but which we may wish to publish, will be paid for at our regular rates.

Piston Valve Packing Ring Contest

The importance of carefully fitting the packing rings to the piston valve and maintaining them carefully was clearly brought out in the papers submitted in the competition on Piston Valve Packing Rings, which closed October 1. It is difficult to measure accurately the loss in steam, and therefore fuel, due to improperly fitted rings, but there can be no question but that the time and labor expended in doing the work properly is very much worth while.

From a careful study of the articles submitted in the contest the judges awarded the prize to W. F. Lauer, general foreman of the Illinois Central, at Memphis, Tenn., this article being printed elsewhere in this issue. Mr. Lauer was the only participant who went into detail concerning the machining of the packing rings. It has been clearly shown that the cost of manufacture is not the only thing to be considered, as a cheaply and poorly made ring may be a costly ring from a service standpoint. It would, therefore, be very desirable to hear from others of our readers regarding the methods followed on their roads for handling this very important detail in locomotive maintenance.

Smokeless Firing and Passenger Revenue

The Baltimore & Ohio Employees' Magazine for September prints, in its "Merit Roll" columns, a letter from P. C. Allen, a superintendent of that road, which reads, in substance, as follows:

"On No. 525 yesterday, I was sitting on the observation platform when I heard a passenger remark: 'You cannot sit out this way on some railroads.' I asked: 'Why can't you?' And he answered: 'So many of them burn soft coal and it is so dirty.' When I got off he said: 'I am coming this way again.' The fireman, C. A. Straw, was making a clean run of it and with *soft coal!*"

Fireman Straw was doing two things for his road—saving fuel by careful firing and advertising the road in the best possible way, i. e., by doing what he could to make the passengers comfortable. It is well known that passenger business does not, as a general rule, produce very large earnings and it is also well known that a smoky and dirty observation platform is worse than if none were provided, for under those conditions it becomes nothing but a tantalization. The best advertisement for a road is a satisfied patron. It is surprising how the reputation of the service a road renders spreads throughout the traveling public. Fireman Straw certainly deserves meritorious recognition. This incident may also serve as another argument for increased supervision in locomotive operations and the education of firemen.

Another Car Department Competition

"Lessons to Be Learned From Experience with Steel Freight Cars," is the subject of a competition, to close December 1, 1915, as announced in our October issue. All-steel and steel underframe freight cars have been in use for many years in large numbers. In the earlier stages of their development much trouble was caused by defects in design and construction, but gradually most of these have been eliminated. As the cars have grown older, however, certain weaknesses have become apparent under continued service which were not evident before the wear and tear had begun to affect the different parts. What are the weak points, and how can they be strengthened, thus reducing the cost of maintenance and extending the life of the car? We want to hear from the practical man as to the difficulties which confront him in the repair and maintenance of these cars. We want his ideas as to how the construction can be improved. We want also to hear from the designer, if he has followed the cars closely after they have gone into service and is familiar with their performance. The topic, as it is expressed in the opening sentence of this note, defines exactly what we want to bring out. A prize of $35 will be given for the best article on this subject received at our offices in the Woolworth building, on or before December 1, 1915. Other articles which we may select for publication will be paid for at our regular rates. The judges will base their decision on the practical value of the suggestions which are made.

Fire Losses and the Mechanical Department

At the recent convention of the Railway Fire Protection Association, the committee on statistics presented a statement of causes of fires and the fire losses, which was obtained from 41 representative roads, reporting and operating mileage of 102,462 miles, or approximately 40 per cent of the entire country, for the two calendar years 1913 and 1914. From this statement the following is taken as being of special interest to the mechanical department:

	Number of Fires	Loss	Percentage of Total Loss
Ashes and hot cinders	301	$51,213.57	2.7
Coal from locomotive fireboxes	493	117,874.83	4.4
Friction, hot boxes, etc	116	90,042.68	1.2
Sparks from locomotives	3,008	899,177.90	26.7
Spontaneous combustion	393	258,852.33	3.5
Torches	142	57,426.92	1.3
Waste and wooden lockers	31	13,936.09	.3
		$1,488,524.32	40.1

The grand total of the complete losses reported for the two years was $5,753,663.90, and the greatest individual item given in the statement was $1,504,486.72 for fires caused from unknown causes. While the totals given in the table above may not be entirely chargeable to the mechanical department, the items enumerated are such as to indicate that the mechanical department may do much to reduce them.

Care should be taken to see that all the ashes and hot cinders removed from locomotives at the cleaning pits are carefully extinguished before being placed in cars or near any wooden

structure. Improper maintenance of ash pans is responsible for damage caused by hot coals from the locomotive fireboxes. Sparks from locomotives, the largest item in the above table, and representing 26.7 per cent of all the fires in the two years mentioned, are a direct result of the improper maintenance of the front end, diaphragm, screens, etc. If this item were pro-rated to all the railroads in this country it would show that about $1,125,000 per year was spent in paying claims from this source, which represents about $25 per road engine per year. It would seem that it would be a profitable investment carefully and properly to maintain locomotive front ends. The other causes, spontaneous combustion, torches, waste and wooden lockers, are items that particularly interest the shop forces, and emphasize the value of keeping the shops clean and neat.

Relationship of the Mechanical and Stores Department

The ambition of mechanical department officers is to keep the power and rolling stock in proper condition and have as great a proportion as possible available for service. This requires a supply of material without which the department will be helpless. The stores department, which sells this material to the mechanical department, is therefore an important factor in the success of the mechanical department. However, its officers also have ambitions. Its duty is to keep enough stock on hand to adequately meet the demands of its customers, and at the same time to keep the amount of money tied up by the investment in material to the lowest possible sum. Its success depends on the proper proportioning of these two factors. The work of the stores department is clerical; but slight mechanical knowledge is necessary. Unassisted it has only the experiences of the past to suggest the needs of the future. With the never ending desire to keep the stock as low as possible, it can readily be seen that unless it is accurately informed as to the needs of the future, the mechanical department may find its effectiveness "nipped in the bud" by lack of material.

It is evident that with the providing of material in the hands of a separate department, which seeks to keep the stock as low as possible, a very close and friendly relation should exist between the two departments. With material such as used daily in more or less uniform quantities there is little if any difficulty. It is the sudden demands that create trouble. Many times, and in fact in most every case, the mechanical department can predict fairly accurately, the amount of material that will be required for the future, and it is to its best interest to see that the stores department is fully informed regarding these requirements. In cases of emergency also the stores department can be of great service to the mechanical department.

Is it not fair and just, therefore, for the mechanical department to do its share toward making the stores department a success and in assisting it to keep the stock down to the lowest practicable point. Without this assistance disastrous results may follow, and with it the relationship between the two departments will be most friendly. The success of both departments is interdependent—without the assistance of the mechanical department the stores department cannot properly supply the necessary material without greatly sacrificing its investment efficiency, and without the assistance of the stores department the mechanical department cannot keep its shop output up to the desired standard.

Car Inspectors' Competition

As noted in our October issue, the car inspectors' competition was the most successful in the number of papers received of any competition that we have ever held. While some of the papers were incomplete, and a number of them were much alike, several exceedingly strong articles were received discussing the question from widely varying viewpoints. It may be said also that the competition was one of the most successful as to the importance of the facts which were developed. Several of the most valuable of the contributions will be published complete in this and succeeding issues; the others will probably be combined into symposiums covering different phases of the subject, but giving each contributor credit for such part as may have been taken from his article.

The prize of $35 has been awarded to A. M. Arr, of the Bessemer & Lake Erie, Greenville, Pa. He discusses quite fully the selection, training and continued development of the car inspector. Particularly good are his suggestions as to selection, and his recommendations concerning the recording of individual efficiency in order that weak spots may be located and strengthened, and the entire staff encouraged to put forth their best efforts in the knowledge that improved individual efficiency will be recognized. This, with the periodical examinations, should do much toward encouraging the inspectors to putting forth their best efforts. The typical examination paper which accompanied Mr. Orr's paper is worth reading and checking by those who are specially interested in this subject.

Of quite a different nature is the contribution by E. C., which is also published in this issue, and which in many ways supplements Mr. Orr's paper. It is well worth reading and studying carefully. One thing is evident—the car inspector's job is no snap. E. C. emphasizes the difficulties under which these men have to work and specially directs attention to the lack of co-operation on the part of the yard operating forces. Let us hope that these conditions are not general, although from reading between the lines of some of the other papers it is evident that they are far more so than they should be. Is it not time that the operating department officers can be an important factor in securing better car inspectors by being more sympathetic toward these men, realizing, as they must, that the work is vitally important to successful and efficient operation and that the inspectors must be allowed a sufficient amount of time for the proper performance of their duties?

We congratulate the car inspectors and their friends on the splendid showing which they made in the competition, and take this opportunity of again thanking them for their cordial co-operation.

NEW BOOKS

Official Proceedings of the Ninth Annual Convention of the Master Boilermakers' Association. Bound in cloth; 230 pages, 6 in. by 9 in. Illustrated. Published by Harry D. Vought, secretary. Price, $1.00.

This volume contains the official proceedings of the ninth annual convention of the Master Boilermakers' Association, held at Hotel Sherman, Chicago, on May 25-28, 1915. The papers and committee reports presented at this convention contain much information of value pertaining to boiler shop practice and boiler and tank construction and should be of considerable value to those having to do with locomotive boiler maintenance. The value of the volume as a reference book is considerably increased by a table of contents. It is well printed and well bound.

How to Make Low Pressure Transformers. By Prof. F. E. Austin, Hanover, N. H. 17 pages, 4 illustrations, 4¼ in. by 7¼ in. Bound in cloth. Published by the author. Price, 40 cents.

This is the second edition of this book published by the author, and contains detailed instructions regarding the design, construction and the operation of small transformers. With these instructions a transformer for 110 or 220 volt line circuits with a frequency of 60 cycles can be stepped down to a minimum of eight volts. The author goes very thoroughly into the matter of construction, and shows it may be built without the use of expensive tools or machinery. Transformers made according to these instructions have given an output of 100 watts with an efficiency of over 90 per cent.

FIRST 4-8-2 LOCOMOTIVES IN CANADA

Two Engines Built by the Canadian Pacific Have Engine Trucks Equalized with Driving System

BY W. H. WINTERROWD
Assistant to Chief Mechanical Engineer, Canadian Pacific, Montreal, Que.

The heavier class of passenger service on the Canadian Pacific has been very largely handled by Pacific type locomotives which are divided into two classes, one with 22½ in. by 28 in. cylinders and 75 in. driving wheels, and the other with 21 in. by 28 in. cylinders and 69 in. driving wheels. The boilers of both classes carry a pressure of 200 lb. The class with the larger driving wheels was fully illustrated and described in the March, 1913, issue of *The American Engineer,* page 117.

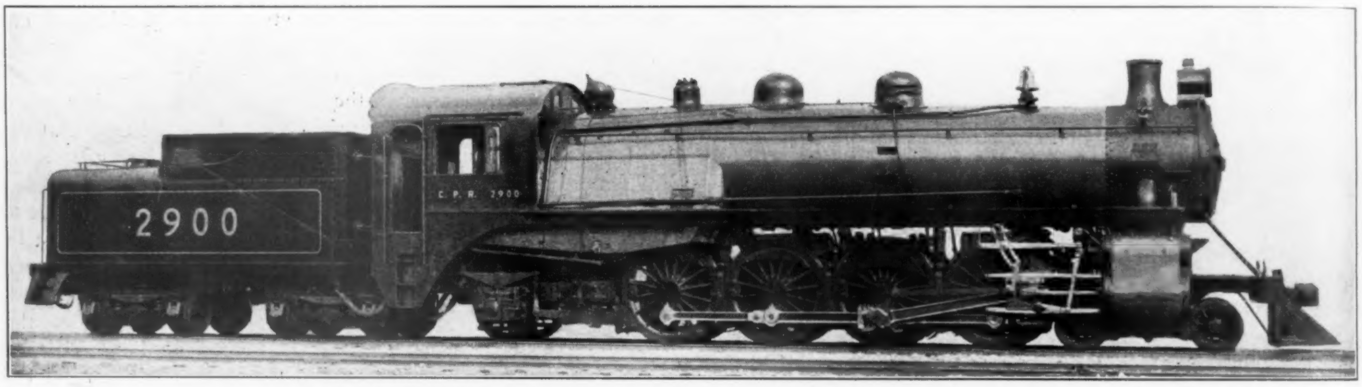
On account of the heavy grades on some of the divisions and on account of the desirability of maintaining schedule speeds with heavy trains without double-heading over these divisions, it became necessary to consider a more powerful locomotive. With this in view the railway company built and put into service in August, 1914, two Mountain type locomotives which are the first of their type built in Canada. These locomotives were designed and built at the company's Angus shops, Montreal, and are identical in practically every respect with the exception of the boilers, one of which is equipped with a Gaines combustion chamber firebox. They have 23½ in. by 32 in. cylinders, 70 in. driving wheels and carry a boiler pressure of 200 lb.

The Pacific type locomotives with the larger drivers and cylinders have a rated tractive effort of 32,100 lb., their total weight in working order, including the tender, being 361,000 lb. On account of bridge and right of way restrictions the Mountain type locomotives are not as heavy as a number of locomotives of the same type in service in the United States. They have, however, a rated tractive effort of 42,900 lb. and weigh 443,000 lb., including the tender. With an increase in weight of 22.7 per cent, tractive effort has been increased 33.6 per cent.

The accompanying table compares briefly the Canadian Pacific Mountain type locomotives and some of the same type operating in the United States.

	Can. Pac. 2900*	Can. Pac. 2901	Rock Island	Ches. & Ohio	Great North.	Missouri Pacific	Seaboard Air Line
Tractive effort, lb	42,900	42,900	50,000	58,000	61,900	50,400	47,800
Weight, total, lb	286,000	286,000	333,000	330,000	326,000	296,000	316,000
Weight on drivers	192,000	192,000	224,000	239,000	218,000	208,000	210,500
Diam. of drivers, in	70	70	69	62	62	63	69
Cyls., diam. and stroke	23½x32	23½x32	28x28	29x28	28x32	28x28	27x28
Steam pressure, lb	200	200	185	180	180	170	190
Heating surface, tubes and flues	3,402	3,929	3,805	3,795	4,200	3,165	3,396
Firebox heating surface	265	221	312	337	340	285	319
Superheater heating surface	760	943	944	845	1,075	761	865
Total equivalent heating surface	4.807	5,564	5,533	5,399	6.153	4,592	5,012
Grate area	59.6	59.6	62.7	66.7	78.0	56.5	66.7
Factor of adhesion	4.48	4.48	4.48	4.12	3.68	4.14	4.38

* Boiler equipped with Gaines combustion chamber.



Canadian Pacific Mountain Type Locomotive with Gaines Firebox

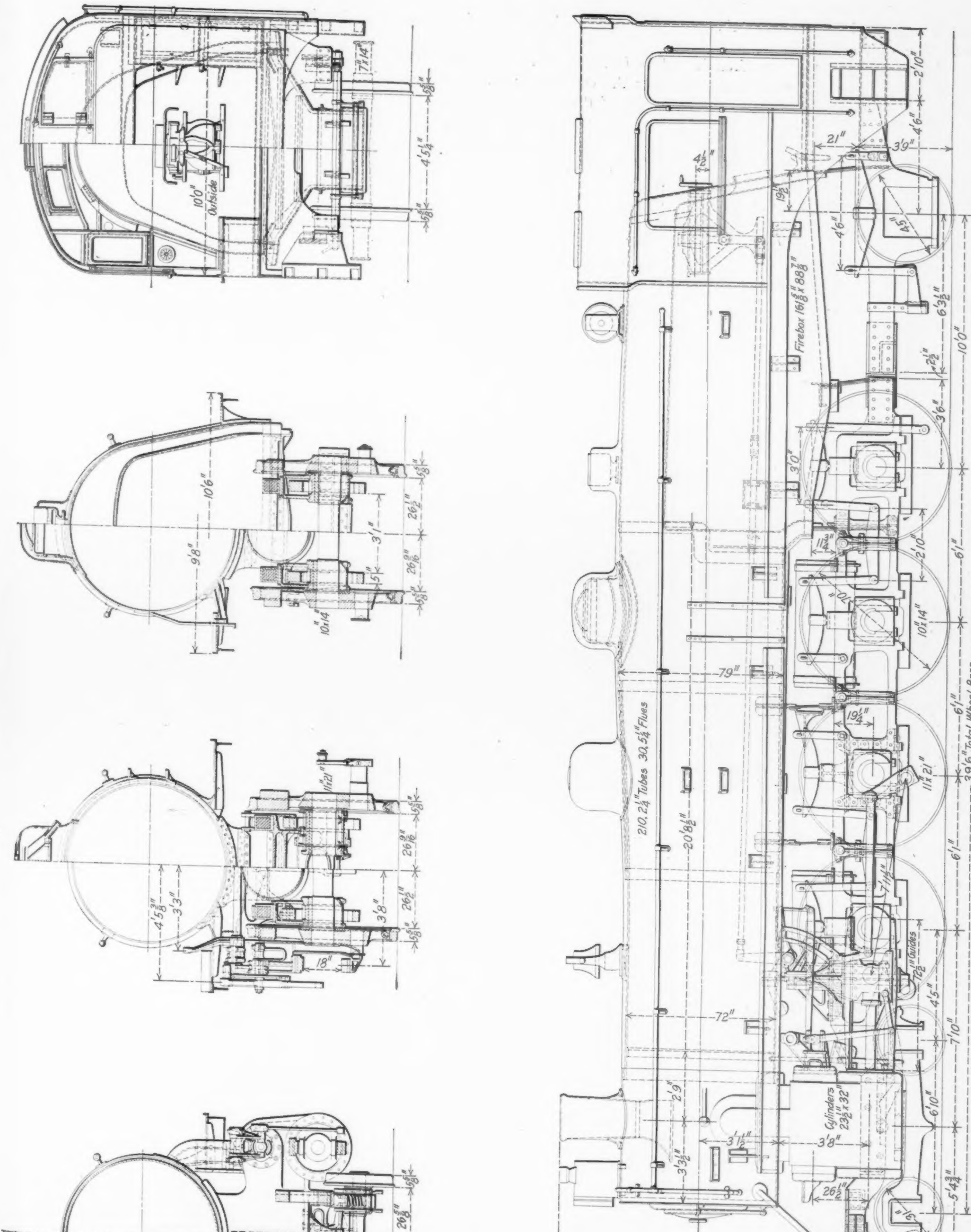
BOILER

Engine 2900 is equipped with the Gaines combustion chamber firebox. The boiler contains 210 2¼-in. tubes and 30 5¼-in. flues. The length over tube sheets is 20 ft. 8½ in. The boiler of engine 2901 is equipped with an ordinary wide firebox and brick arch. It contains 43 2¼-in. tubes, 136 2½-in. tubes and 30 5¼-in. flues, the length over tube sheets being 25 ft. 4½ in. By the American Locomotive Company's method of calculating boiler capacity, the boiler equipped with the Gaines combustion chamber is rated at approximately 110 per cent and the boiler with the ordinary wide firebox, approximately 105 per cent. By the same method the boilers of the Pacific type locomotives are rated at approximately 90 per cent.

The firebox equipped with the Gaines combustion chamber is 7 ft. 4⅞ in. wide and approximately 13 ft. 6 in. long at the mud ring. The grates extend toward the back tube sheet 7 ft. 11 in. and have an area of 59.6 sq. ft. At the front of the grates is placed the vertical brick wall of the combustion chamber which is 10 in. thick and carries five vertical air passages, each 3 in. in diameter. The distance between the wall and the back tube sheet is 4 ft. 11½ in. The brick arch is carried on four 3½-in. arch tubes which are straight, except at the back tube sheet where they are curved on a radius of 3 ft. so that the ends form a right angle with the tube sheet.

On account of the depth of the firebox the floor of the combustion chamber is raised above the level of the grates in order to clear the rear driving wheels. These wheels are directly under the combustion chamber and extend into the firebox, the floor of the combustion chamber being inclined from each side of the firebox toward the cinder hopper.

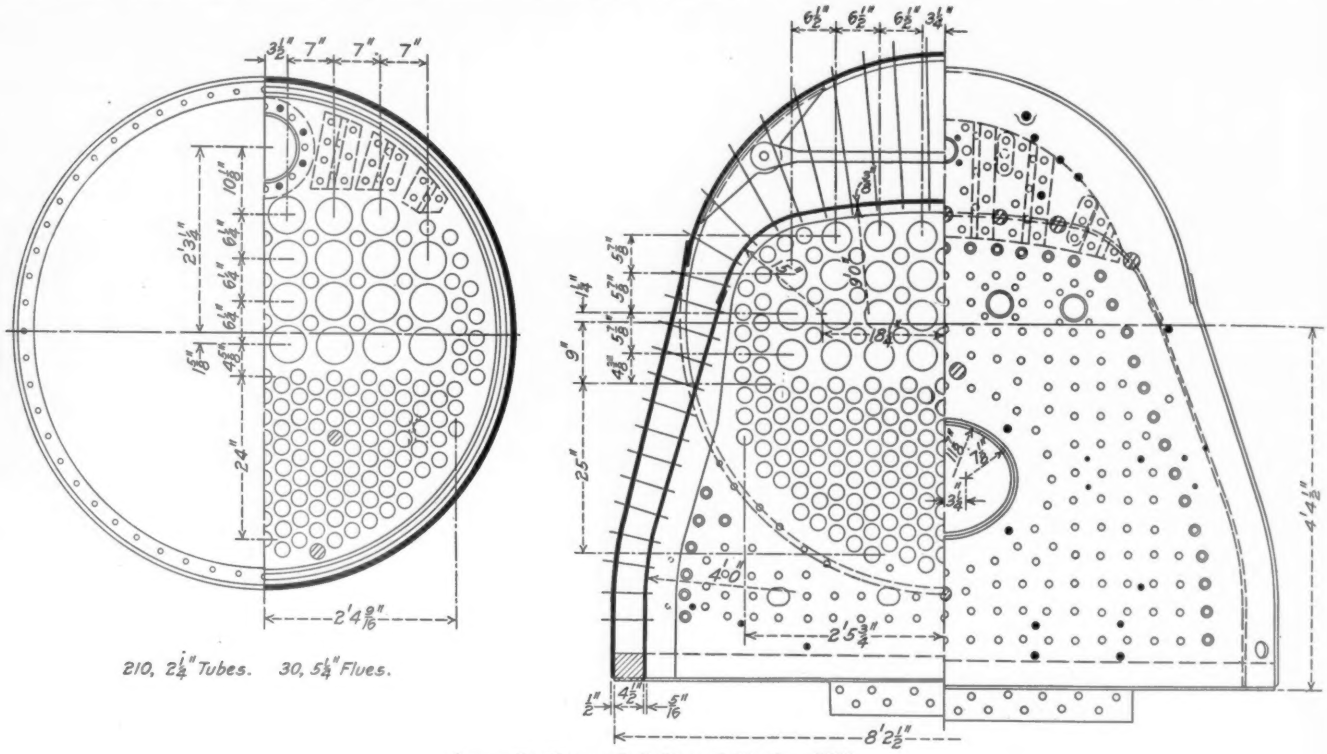
The mud ring is forged and slopes downward from both front and back toward the base of the vertical bridge wall. The



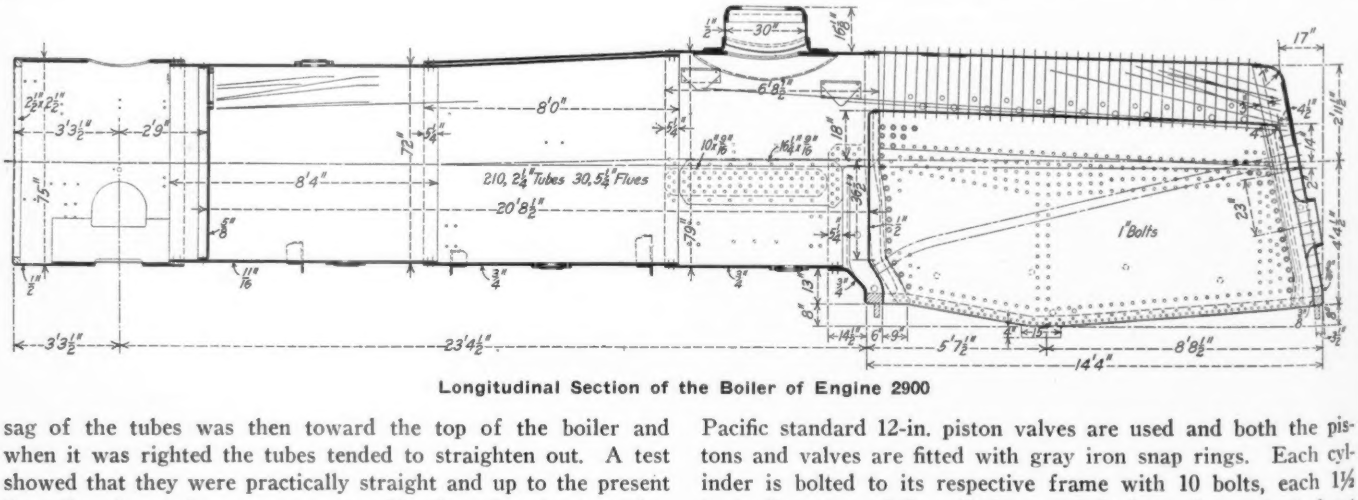
Elevation and Sections of Canadian Pacific Mountain Type Locomotive

firebox is supported by expansion sheets at the front, back and center. The center sheet is supported at the base on a steel casting bolted between the rear frames and is fastened at the top to the transverse steel casting that supports the combustion chamber wall. This casting extends the full width of the firebox and is lipped under the mud ring to serve the double purpose of wall support and firebox support. The expansion sheets are double, each being made of two ⅜-in. plates separated at the top and bottom by ½-in. liners. They fit against shoulders at the top and bottom, thus relieving the bolting from shearing stresses.

The tubes in the boiler of engine 2901, which are 25 ft. 4½ in. long, were beaded into place before the boiler was applied to the frames, with the boiler turned upside down. The center sag of the tubes was then toward the top of the boiler and when it was righted the tubes tended to straighten out. A test showed that they were practically straight and up to the present time they have given no more trouble than the shorter tubes in engine 2900.



Cross Sections of Boiler of Engine 2900



Longitudinal Section of the Boiler of Engine 2900

FRAMES

The main frames of both engines are of vanadium cast steel, the upper rails having a section 5 in. wide by 6½ in. deep and the lower rail a section 5 in. wide by 3¾ in. deep. The single rail front frames are cast integral with the main frames. They have a section 3½ in. wide by 12 in. deep under the cylinders and are 3½ in. wide by 8½ in. deep where the front frame filler or spider casting is bolted. The rear frames and the pedestal binders are of mild steel. The main frames are spaced 39½ in. between centers and the rear frames 74¼ in. between centers.

CYLINDERS

The cylinders are of cast iron and are the same as those used on the Canadian Pacific standard Mikado and ten wheel type hump switch engines with the center line of the steam chest ½ in. inside of the center line of the cylinder. In designing these cylinders particular attention was given to the steam and exhaust passages, which are unusually direct and of liberal cross sectional area. The cylinders and steam chests are fitted with gray iron bushings the walls of which are one inch thick. Canadian Pacific standard 12-in. piston valves are used and both the pistons and valves are fitted with gray iron snap rings. Each cylinder is bolted to its respective frame with 10 bolts, each 1½ in. in diameter and the cylinders are bolted together at both front and back with single rows of nine 1¼-in. bolts. There is also a bottom bolting flange containing four 1½-in. bolts.

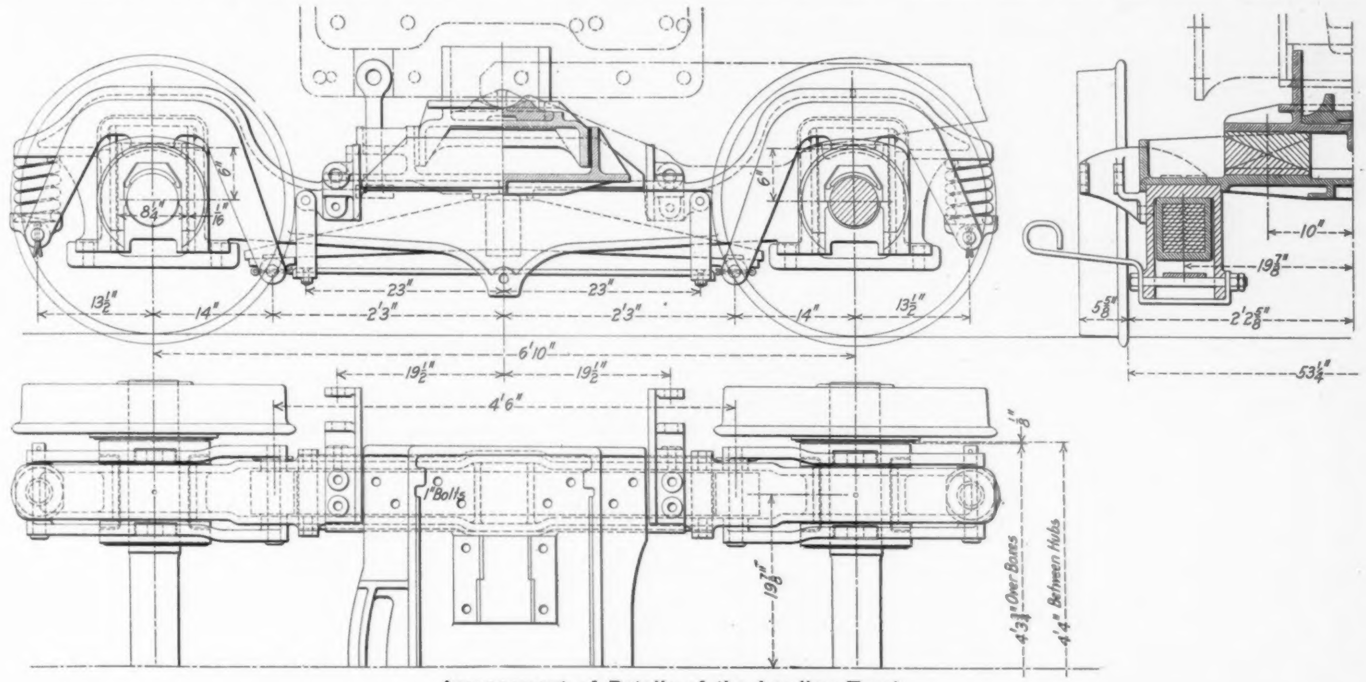
ENGINE TRUCK

The equalizing system between the engine truck and driving wheels is that patented by H. A. Hoke, assistant engineer, Pennsylvania Railroad, and in use on a number of Pennsylvania locomotives with four-wheel engine trucks. Its appli-

cation to the Pennsylvania class E6s Atlantic type was described in detail in the *Railway Age Gazette, Mechanical Edition* for February, 1914, page 66. The weight on the engine truck is equalized with the weight on the first and second pair of driving wheels, while the third and fourth pair of driving wheels are equalized with the trailer truck. The main equalizer is of wrought iron of the fish belly type. It is 6 ft. 9 in. long over all and at the point where the fulcrum pin is applied has a cross sec-

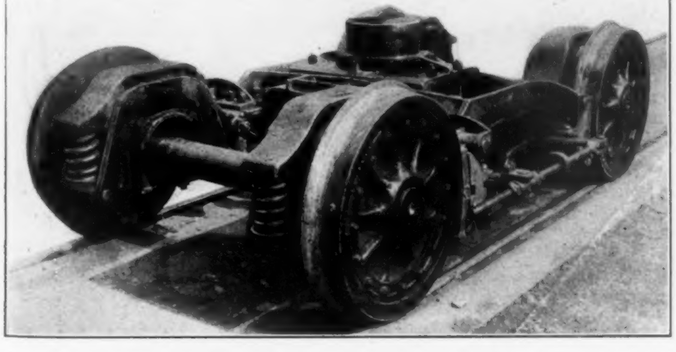
bolted a cast iron bushing with walls ¾ in. thick, which forms the wearing surface for the center casting. This bushing has an opening at the back 7½ in. wide which extends the full depth of the casting, and is provided with a collar at the bottom, which fits against the bottom edge of the vertical guide.

The engine truck center casting is made of cast steel. Its upper portion, which fits into the vertical guide, is made in the form of a hollow cylinder with walls one inch thick, in the



Arrangement of Details of the Leading Truck

tion 4 in. wide by 12 in. deep. The back end is supported by a hanger from the cross equalizer. The front end is supported in a specially designed casting which forms a part of the engine truck. The fulcrum pin is supported in two steel castings fitted and bolted together directly beneath the cylinders. Each casting is bolted to a main frame with eight of the 1½-in. bolts which are used to secure the cylinder castings to the frame, and is also bolted to the bottom of the cylinder casting with six 1½-in. bolts. The castings are bolted together at the center with four 1½-in. and two 1¼-in. bolts. The 1½-in. bolts pass through the bottom bolting flanges of the cylinder castings. The castings are carefully fitted and bolted into place and serve also



Leading Truck for Canadian Pacific Mountain Type Locomotives

as a front frame cross tie, engine truck center casting guide and support for the engine truck safety hanger.

To form a guide for the truck center casting, each of the fulcrum castings is so cored that when both are in final position the center portion forms a circular vertical guide 15½ in. in diameter with walls ¾ in. thick. In the back of this guide is a vertical opening 7½ in. wide Into the guide thus formed is

back of which is a full depth opening 7½ in. wide through which the front end of the main equalizer passes. The bearing surface on the end of the equalizer is convex with a radius of 3½ in, and rests upon a concave cast steel equalizer seat supported by the engine truck center casting. The equalizer seat is 11¾ in. in diameter and is provided with guiding ribs which engage the sides of the equalizer to prevent the seat from turning under the latter. The lower part of the casting is rectangular in form and fits between transverse vertical walls on the cast steel truck frame cross tie, which forms the guiding surfaces for the lateral swing of the truck in curving.

The truck is centered by double-faced wedges, the wearing faces of which are inclined 1 in. in 2½ in. The top pair of wedges are bolted to the under side of the center casting and the bottom pair to the floor of the truck frame cross tie. The vertical guiding walls of the latter are joined at the ends to longitudinal vertical walls 4¼ in. high, thus forming a rectangular reservoir open at the top, which is kept partly filled with oil for the lubrication of the centering wedges. Oil pipes readily accessible from the front of the engine lead to this reservoir. Wrought iron wearing strips are riveted to the inside of the front and back guiding walls.

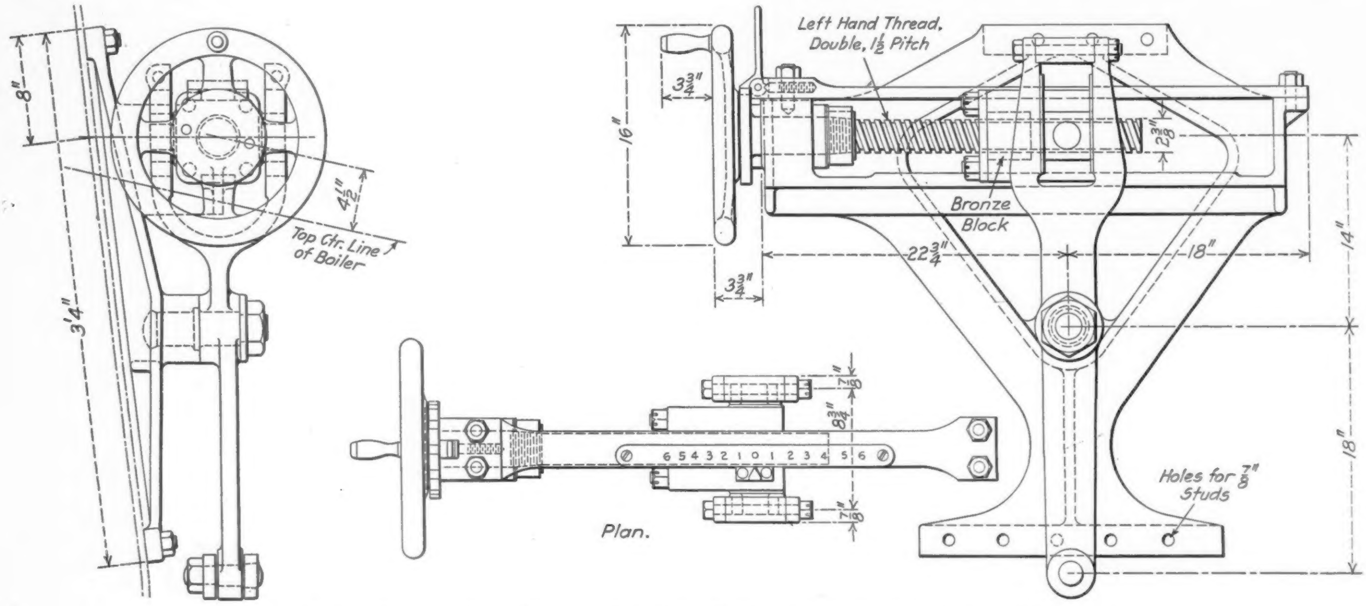
Through a reinforced extension on the front of the cross tie casting is a slot 2½ in. wide and 16 in. long formed on a radius of 2 ft. 8 in. Through this slot is passed the engine truck safety hanger, a wrought iron eye bolt 1¾ in. in diameter with a tee head on the bottom end. This safety hanger is hung on a 1¾-in. wrought iron pin supported by the equalizer fulcrum castings.

The engine truck side frames are of steel cast integral with the journal box pedestals, which are spaced 6 ft. 10 in. between centers. They are of channel section with side walls ⅞ in. thick and are spaced 39¾ in. apart from center to center. In the center of each side frame is cast a spring seat in which rests a semi-elliptic spring made up of 13 7/16-in. by 5-in. plates. The springs

are supported at the ends on cast iron spring seats which are secured to the inner ends of inverted U-shaped equalizers. The middle point of these equalizers rests on the truck boxes and the outer ends carry the lower seats for coil springs, the upper ends of which bear against the side frames. With 31-in. wheels mounted on axles with 6-in. by 12-in. journals, the truck, complete in working order, weighs 11,250 lb. Actual service has demonstrated that this truck equalized with the drivers makes a very easy riding engine.

REVERSE GEAR

The engines are both equipped with a screw reverse gear of the type shown in one of the drawings. The screw mechanism is supported by a cast steel bracket fastened to the side of the firebox with ⅞-in. studs. A wrought iron reverse lever, which transmits the motion from the screw to the reach rod, is also supported from the bracket by a wrought iron, case hardened pin 2½ in. in diameter. Below the fulcrum pin the lever has a section approximately 1¼ in. thick by 4 in. wide. The upper end of the lever is made with jaws which engage swivel guides supported by the screw block. The main jaw straddles the screw block and the secondary jaws each straddle a swivel guide filler blocks held in place by ¾-in. bolts closing the top of the secondary jaws. These jaws are faced with 3/16-in. case hardened steel liners, held in place with 5/16-in. countersunk rivets.



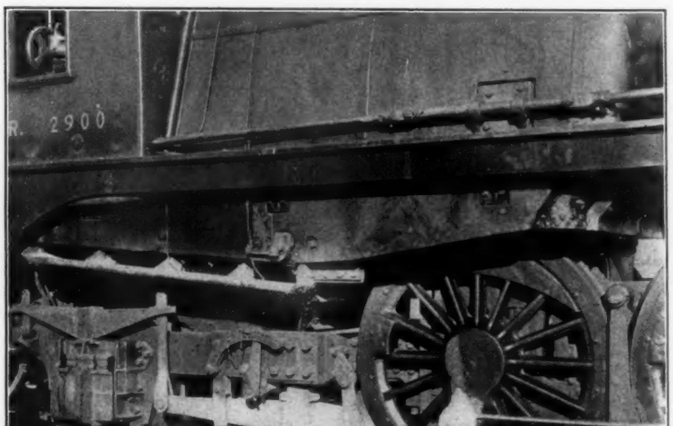
Screw Reverse Gear Used on Canadian Pacific Mountain Type Locomotives

The screw rod is 2⅜ in. in diameter and is provided with threads of 1½-in. pitch. When the gear is in forward position the link block is in the lower half of the link. In order to maintain the standard direction of movement for the top of the hand wheel, which is from left to right toward forward motion and from right to left to reverse, the threads on the screw are made left hand. To move the gear from center to forward motion the screw block moves forward. The lever reverses this motion causing the reach rod to move backward. The forward end of the reach rod is connected to the top arm of a bell crank, the horizontal arm of which extends backward, thus lowering the link blocks when the reach rod moves backward. The hand wheel, screw bearings, locking latch and position indicator are the same as those of the standard screw reverse gear used on Pacific and Mikado type locomotives.

The reach rod, which is very long on both engines, is made in three sections of extra heavy wrought iron pipe. The intermediate section works in a cast iron guide with bushed bearing surfaces. On engine 2900 this guide is bolted to the right side of the firebox close to the throat sheet and slightly above the running board; on engine 2901 it is fastened to the barrel of the boiler. The front and back sections of the reach rod are fitted with cast steel jaws screwed into place and held with jam nuts, while the intermediate rod is fitted with eye ends, 1¾-in. mild steel pins being used to connect the front and back to the intermediate section. The reach rod enters the cab practically parallel with the running board.

Both engines are equipped with Cole driving boxes on the main journals. These journals are 11 in. by 21 in. while the others are all 10 in. by 14 in. The trailing truck journals are 7 in. by 14 in. Canadian Pacific standard vestibule cabs are provided on both engines. On account of the screw reverse gear occupying practically the entire space between the boiler and side of the cab, a non-lifting injector is applied on the right side of the engine, a lifting injector being placed on the left side.

The tenders have a coal capacity of 12 tons, and a water capacity of 6,000 Imperial gallons and are equipped with air operated coal pushers. They are Canadian Pacific standard, known as the combination type in which the underframe forms a part of the tank structure.



View at the Rear End of Engine 2900, Showing the Driving Wheel Extending into the Combustion Chamber Portion of the Firebox

In addition to its use in the main frame, Vanadium steel is used in the main crank pins.

The principal data and dimensions are given in the following table:

	2900—Class H-1-a	2901—Class H-1-b
General Data		
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Passenger
Fuel	Bituminous	Bituminous
Tractive effort	42,900 lb.	42,900 lb.
Weight in working order	286,000 lb.	286,000 lb.
Weight on drivers	192,000 lb.	192,000 lb.
Weight on leading truck	53,000 lb.	52,000 lb.
Weight on trailing truck	41,000 lb.	42,000 lb.
Weight of engine and tender in working order	443,000 lb.	443,000 lb
Wheel base, driving	18 ft. 3 in.	18 ft. 3 in.
Wheel base, total	39 ft. 6 in.	39 ft. 6 in.
Wheel base, engine and tender	66 ft. 6 in.	66 ft. 6 in
Ratios		
Weight on drivers ÷ tractive effort	4.48	4.48
Total weight ÷ tractive effort	6.665	6.665
Tractive effort × diam. drivers ÷ equivalent heating surface*	625	539
Equivalent heating surface* ÷ grate area	80.7	93.4
Firebox heating surface ÷ equivalent heating surface,* per cent	5.5	3.92
Weight on drivers ÷ equivalent heating surface*	39.9	34.5
Total weight ÷ equivalent heating surface*	59.5	51.4
Volume both cylinders	16.08 cu. ft.	16.08 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	299	346
Grate area ÷ vol. cylinders	3.71	3.71
Cylinders		
Kind	Simple	Simple
Diameter and stroke	23½ in. by 32 in.	23½ in. by 32 in.
Valves		
Kind	Piston valve	Piston valve
Diameter	12 in.	12 in.
Greatest travel	6½ in.	6½ in.
Outside lap	15/16 in.	15/16 in.
Clearance (exhaust)	3/16 in.	3/16 in.
Lead in full gear	5/16 in.	5/16 in.
Wheels		
Driving, diameter over tires	70 in.	70 in.
Driving, thickness of tires	3½ in.	3½ in.
Driving journals, main, diameter and length	11 in. by 21 in.	11 in. by 21 in.
Driving journals, others, diameter and length	10 in. by 14 in.	10 in. by 14 in.
Engine truck wheels, diameter	31 in.	31 in.
Engine truck, journals	6 in. by 12 in.	6 in. by 12 in.
Trailing truck wheels, diameter	45 in.	45 in.
Trailing truck, journals	7 in. by 14 in.	7 in. by 14 in.
Boiler		
Style	Extended wagon top	Wagon top
Working pressure	200 lb. per sq. in.	200 lb. per sq. in.
Outside diameter of first ring	72 in.	72 in.
Firebox, length and width	161⅝ in. by 88⅞ in.	96¼ in. by 88⅞ in.
Firebox plates, thickness	½ in., ⅜ in., 5/16 in.	½ in., ⅜ in., 5/16 in.
Firebox, water space	6 in., 4½ in., 3½ in.	5 in., 4½ in., 3½ in.
Tubes, number and outside diameter	210—2¼ in.	43—2¼ in., 136—2½ in.
Flues, number and outside diameter	30—5¼ in.	30—5¼ in.
Tubes and flues, length	20 ft. 7⅜ in.	25 ft. 3⅜ in.
Heating surface, tubes	2,552 sq. ft.	2,887 sq. ft.
Heating surface, flues	850 sq. ft.	1,042 sq. ft.
Heating surface, firebox	265 sq. ft.	221 sq. ft.
Heating surface, total	3,667 sq. ft.	4,150 sq. ft.
Superheater heating surface	760 sq. ft.	943 sq. ft.
Equivalent heating surface*	4,807 sq. ft.	5,564 sq. ft.
Grate area	59.6 sq. ft.	59.6 sq. ft.
Smokestack, diameter	16½ in.	16½ in.
Smokestack, height above rail	15 ft. 3 7/16 in.	15 ft. 3 7/16 in.
Center of boiler above rail	9 ft. 8½ in.	9 ft. 8½ in.
Tender		
Tank	Water bottom	Water bottom
Frame	Combined tank and frame	Combined tank and frame
Weight	157,000 lb.	157,000 lb.
Wheels, diameter	36¼ in.	36¼ in.
Journals, diameter and length	6 in. by 11 in.	6 in. by 11 in.
Water capacity	6,000 Imp. gals.	6,000 Imp. gals.
Coal capacity	12 tons	12 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

The Pyrometer in Steel Making.—In the experiments on rail manufacture which the U. S. Bureau of Standards is conducting at the plant of the Maryland Steel Company, Sparrows Point, Md., particularly with reference to a comparison of Hadfield and domestic ingots, attempts are being made to determine whether it is possible to control the operation of the Bessemer, open-hearth and other processes by the aid of the pyrometer.—*The Iron Age.*

SMOKELESS LOCOMOTIVE OPERATION WITHOUT SPECIAL APPARATUS*

BY H. H. MAXFIELD
Master Mechanic, Pennsylvania Railroad, Pittsburgh, Pa.

The problem of eliminating objectionable smoke from steam locomotives is naturally divided into two parts, first, terminal, or engine house operation, and second, road operation. If the elimination of objectionable smoke can be accomplished at engine terminals, and the locomotives turned over to the crews with fires in such a condition that it is not necessary to do much in the way of heavy firing while passing through the restricted area, the problem is more than half solved.

The Terminal Problem.—The first essential is that the locomotive be delivered by the crew at the ashpit with the fire in good condition, i. e., not badly burnt out nor yet full of green coal, but having a medium-sized, bright fire. This permits cleaning and banking the fire with a minimum of smoke.

The second essential is the careful cleaning and rebuilding of the fires and banking them in case the locomotive is to remain at the terminal for any length of time. These operations being completed, the locomotive is moved to the engine house or storage yard, and from then on until the crew assumes charge, the burden is on the engine watcher, who must see that the fire is properly maintained until the crew assumes charge. If the fire is properly cleaned, rebuilt and banked, the engine watcher has a comparatively simple problem confronting him.

The third essential is the proper preparation of the fire for service by the fireman upon taking charge of the locomotive. The first and second essential having been properly taken care of, here again the problem is not difficult.

The methods of cleaning, building up, banking and the building of new fires as practiced at our engine terminals located within the limits of the City of Pittsburgh, are well illustrated by the following instructions:

RULES AND REGULATIONS FOR CLEANING AND BUILDING FIRES IN LOCOMOTIVES

Black smoke shall not be made.

Cleaning Fires.—When cleaning fires at the ashpits, the blower shall be used with sufficient strength to keep down black smoke. One-half of the fire shall be cleaned at a time. After the ashes are knocked out over one-half of the grate surface, this grate surface should then be covered with gas coal, and a layer of low volatile coal placed over this. The good fire should then be thrown over this coal to allow cleaning the other half of the grate. After this half of the grate has been cleaned, it should be covered with a similar amount of gas and low volatile coal, and the burning fuel on the opposite side pulled over it until an even depth of fire is obtained over the entire grate surface. If more coal is then needed to build up the fire the hostler shall use only low volatile coal, which has been thoroughly wet with water.

Banking Fires.—All coal used for this purpose shall be low volatile coal, and shall be thoroughly wet with water. Banking shall be started at the rear end of the firebox and built forward until the fire has been covered within two or three feet of the front flue sheet. The fire shall be heaviest along the side sheets and of minimum depth in the center. In case a banked fire needs more coal supplied, low volatile coal shall be used exclusively. If there is no low volatile coal on the tender the hostler shall report this condition to the engine house foreman and receive instructions.

Building Fires.—The entire surface of the grate shall be covered with 3 in. of gas coal spread over evenly, and upon this an even layer of 4 or 5 in. of low volatile coal thoroughly wet shall be placed. Extreme care shall be used to see that the coal is spread evenly so as to cover the entire grate surface, and no holes should be left in it. Dry shavings shall be distributed over the entire surface of the coal, care being taken that the shavings shall be placed along the side sheets of the firebox. One bucket of shavings, which has been mixed with one quart of fuel oil, shall be evenly distributed on top of the dry shavings. When this has been done, the shavings should then be ignited by a small piece of waste thrown into the middle of the firebox. The blower should then be operated very lightly until the coal shall have become ignited, when the strength of the blower should be increased gradually.

The door shall be kept wide open when fire is started, but after the coal has become thoroughly ignited the door may be closed, depending upon the smoke conditions at the stack. Under no circumstances shall the fire be hooked. If more coal should be needed, wet low volatile coal shall be supplied, but in small quantities. The house blower shall not be used if the locomotive in which fire is being built has 50 lb. steam pressure. When the steam pressure reaches 50 lb. on the locomotive in which a fire is being built, the house blower shall be disconnected.

The use of low volatile coal is to be noted. This coal contains approximately from 20 to 22 per cent of volatile matter. The use of this coal, while not essential to the operation of locomotives at a terminal without objectionable smoke, is unquestionably a great aid, especially at congested points where it is necessary

* Abstract of paper presented at the tenth annual convention of the International Association for the Prevention of Smoke.

to handle a large amount of power in a minimum of time. The placing of a layer of gas coal on the grate under the low volatile coal, when building new fires, as well as when cleaning fires, is an expedient for preventing the low volatile coal, due to its fineness, dropping into the ashpans, thus avoiding the necessity for a second cleaning. As the fire ignites from the top down, the volatile matter from the gas coal is ignited and consumed before passing out of the firebox. The wetting of the coal is an expedient that has given excellent results from a smoke prevention standpoint and has not produced any injurious results. In order to place low volatile coal on the tender, so that it will be accessible, special chutes were installed on the coal wharf, and in order that a limited supply may be accessible when needed, small platform bins have been erected at convenient points so that the hostler can obtain it practically without getting off the locomotive. The low volatile chutes on the wharf have been equipped with sprinkler pipes, so that the coal is wet as it flows into the tenders.

Our method of banking fires not only eliminates, to a large extent, objectionable smoke, but it also enables us to turn the locomotive over to the engine crew with a heavy, bright fire, which requires very little working on the part of the fireman, and this enables him to avoid objectionable smoke. Our 28th Street, Pittsburgh, engine terminal handles, on an average, 175 locomotives in 24 hours. Approximately 35 fires are built daily, about 75 per cent of them being built out of doors. An average of 100 engines per day have fires cleaned or built at this point.

The Road Problem.—The topography of the country in which Pittsburgh is situated seriously complicates the problem of smoke regulation. The problem is a still more complicated one by the movement of heavy tonnage trains originating miles outside of the city limits, then running as high as sixteen or more miles through the city, over comparatively heavy grades, through residential sections, and either through or alongside of important city parks.

Each division handles all smoke regulation matters arising within its own operating territory. A large number of special observers are stationed at the various strategic points for several days at a time, to obtain exact data on the smoke situation. The railroads co-operate in every way with the Bureau of Smoke Regulation of Pittsburgh through its representatives and chief, Mr. Henderson. Copies of daily reports of smoke inspectors are forwarded to the bureau. The railroad takes prompt action on all complaints of objectionable smoke received from the bureau and the bureau is advised as to the result of the investigation of the complaint and what action is taken in order to prevent repetition. All enginemen and firemen have been given printed instructions covering the proper method of firing and operating locomotives in order to obtain efficient and smokeless operation. The essentials of these instructions follow:

The burning of bituminous coal in a locomotive requires air, which must be admitted through the grates and through the fire door.

Smoke means waste of coal and must be avoided.

Large quantities of coal placed in the firebox at one time cool down the fire, cause smoke and waste coal; small quantities at regular intervals will keep the fire bright, prevent smoke and take less coal to keep up steam pressure.

Lumps of coal should be broken in pieces not larger than 3 in.

A bright and level fire over the whole grate must be carried whenever possible. When a sloping fire is used no more coal should be banked at the door than is necessary.

To prevent smoke and save coal the fire door must be placed on or against the latch after firing coal or using the scraper, slash bar or hook, and when on sidings, in yards, at terminals or before starting.

Before the throttle is closed the blower must be used and the door placed on the latch. Fireman must stop firing long enough before steam is shut off to prevent smoke and waste of coal.

The grates must be shaken as often as necessary to clear the fire of ash and clinker in order to admit sufficient air, and in such a manner as to avoid the loss of good fire. Care should be taken to place the grates level after each operation.

Coal can be saved by the proper use of the injector in pumping the locomotive regularly, and by taking advantage of every opportunity to fill the boiler when not working the locomotive to full capacity; also by using the injector to avoid the safety valve's blowing off.

Coal will be saved by always working the locomotive (except when starting) with a full throttle when the cut-off is one-quarter of the stroke or greater, but if one-quarter cut-off with full throttle gives more power or speed than is needed the reverse lever should be left at one-quarter cut-off and the throttle partially closed as needed.

The railroad feels that considerable progress has been made in the effort to eliminate objectionable smoke, the best proof of this being the fact that during the first six months of 1915 there was a reduction of over 78 per cent in the number of complaints of objectionable smoke received from the Bureau of Smoke Regulation as compared with the last six months of 1914. In conclusion, it can be said that the spirit of co-operation which exists between the Bureau of Smoke Regulation of the City of Pittsburgh and the railroad officers has been responsible, in the greatest measure, for the results obtained.

FIRE HAZARDS AT COALING STATIONS

At the second annual meeting of the Railway Fire Protection Association, held in Chicago, October 5-7, an interesting report was read on the fire hazards at coaling stations. The following, which concerns the maintenance of coaling stations, is taken from it:

The hazards encountered in the care of coaling stations consist of open lights, poor housekeeping and spontaneous combustion, all of which may be eliminated by the exercise of ordinary care and attention. Open lights, such as torches, lighted matches and lamps, should never be permitted within the building. Bonfires should not be allowed within 50 ft. of the structure. Poor housekeeping is, broadly speaking, a lack of tidiness and order. Oily waste should be deposited in metal cans, which should be emptied daily, and the premises should be kept free of any accumulation of rubbish. All oily clothes should be hung up in standard metal lockers. Oil for lubrication or fuel should be stored in a small metal-clad house located not less than 30 ft. from the main building. Gasoline should be stored in a standard concrete or brick pit located at the same distance.

The danger from locomotive sparks may be reduced to a minimum by destroying birds' nests built on the outside timbers and by keeping the structure in good repair so that there will be no crevices or decayed parts where a spark may lodge. All highly inflammable substances which collect in concealed places and absorb moisture are subject to spontaneous heating and particular attention should be given to preventing accumulations of refuse, oily clothes or waste and coal dust in any part of the station. Spontaneous heating is also due to wet coal being unloaded into the pockets, where it sticks to the sides or bottom and becomes packed, causing it to heat.

It was recommended that the following rules be posted in some conspicuous place at each coaling station:

Bins must be cleaned of all accumulation of coal and coal dust at least once each week, and oftener if thought necessary. At the time the chute is cleaned special attention should be given to the removal of coal dust on all beams.

The engineer must make a careful inspection each day of all bearings and observe the condition of the coal. He shall keep a daily record of these inspections and report them weekly to his superior officer.

Water must not be applied to coal in the cars or in the chute for the purpose of laying the dust.

Greasy clothing and oily waste must not be left in any part of the coaling station.

Smoking in and around the coaling station is forbidden.

Open lights of any description are prohibited, except in case of emergency.

A book will be furnished the operator by the proper division official for the purpose of keeping a record, giving the date of cleaning and describing in detail the manner in which the chute was cleaned. This record must be reported each week by the operator to his superior officer, who will transmit the report monthly to the superintendent.

Fire apparatus of all description must be examined at the time the coal chute is cleaned and defects reported immediately.

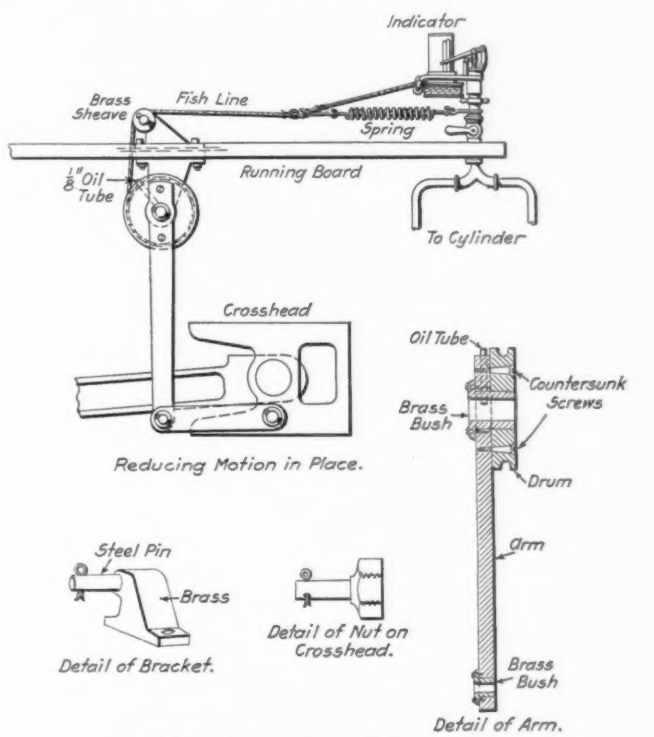
Blowers on locomotives or ash pans should not be opened in the vicinity of coaling plants.

INDICATOR REDUCING MOTION

BY HUGH G. BOUTELL

The accompanying sketches show the general arrangement and details of an indicator reducing motion used by one of the southern railroads. It was gotten up by the men in charge of the dynamometer car and has proved very successful in actual service.

The arrangement consists of a wooden arm suspended from a bracket on the running board or guide yoke and connected to the cross-head by a short wooden link. At its upper end the arm is securely attached to a drum, also made of wood and turned with a U-shaped groove on its circumference. To this drum is attached a stout piece of fish line, which runs up through a hole in the running board and over a small sheave supported by a bracket on the running board, to a long coil spring of a type similar to those used for screen doors. The other end of this spring is made fast to the indicator pipe from the cylinders, though, of course, any convenient point of attachment would serve equally as well. Where the fish line joins the spring there is a loop made of iron wire, and into this the cord from the



Simple Indicator Reducing Motion

indicator may be hooked. The appearance of the rigging when in place is clearly shown in the sketch.

The arm and drum are made of oak and have an advantage over similar parts made of metal, as they are much lighter and possess very little inertia. Brass bushings are inserted as shown and held in place by screws through flanges on one end of the bushings. The upper bushing is provided with a 1/8-in. oil pipe which passes through a hole in the arm and may be kept filled with waste soaked in oil. The drum and arm are held together by large countersunk screws. The link is merely a straight piece of oak, with a suitable brass bushing at the cross-head end and a pin at the other. For connection to the cross-head a special nut, with a pin on one end, was made to take the place of one of the ordinary nuts. The brackets are simple brass castings, and as the base of the bracket which supports the arm is the same as that of the one for the sheave, only two bolts through the running board are necessary, one additional hole being necessary for the cord to work through. Of course, the design of these brackets can be varied to suit the particular requirements of the engine, and on some locomotives it will be found more convenient to support the arm from the guide yoke, or perhaps some portion of the valve gear.

By suitably proportioning the length of the arm and the radius of the drum any desired reduction may be obtained, and unlike some forms of reducing motion in common use, this arrangement gives a motion to the indicator drum, which is practically a true reproduction of that described by the cross-head. Where quite a number of tests are being run, covering a comparatively long period of time, the engine may be safely sent out between test runs with the reducing motion in place, as it is very substantial and will require no attention beyond occasional oiling, the same as any of the other moving parts.

CALIBRATION CHARTS FOR VANDERBILT TENDERS

BY TOWSON PRICE

It is generally desirable to have calibration charts, or curves showing the amount of water contained for all depths of water, for all classes of tenders. These charts are very useful in making engine tests where a record is kept of the amount of water used, as it is much easier to measure the depth of water and read the amount from a chart than to weigh the tender repeatedly.

The data for constructing a calibration chart may be obtained by weighing the tender empty and with various heights of water in the tank and drawing the curve through the points so found, or by calculating the tank capacity for various heights of water and so obtaining points on the required curve. If no drawing of the tender is available the first method is the simpler, but care should be taken to have the tender nearly level and water heights should be taken at opposite corners and averaged. If a drawing of the tender is available or can be readily made and it is not convenient to keep the tender out of service while the weights are obtained, it will be necessary to obtain the calibration curve by calculating the tank capacity for various heights of water.

The Vanderbilt tender presents the greatest difficulties to the calculation of capacity for various depths of water, and that

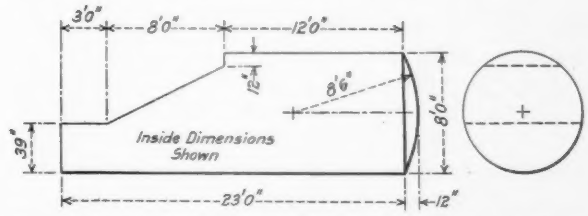


Fig. 1—Water Space Dimensions for a Vanderbilt Tank

type of tank will be considered in this article. The necessary dimensions of one of these tanks are given in Fig. 1. If a drafting room is available, this tank may be laid out to large scale, cut up into horizontal strips, the average length of these strips being obtained by scale and the cross sectional area determined with a planimeter or by multiplying the height by the average width. But if a drawing board is not available or it is desired to make the curves for a number of similar tanks the work may be done by calculation, using a slide rule and a table of areas of circular segments.

For convenience and in order that the two points will be located where a break in the smoothness of the curve takes place, the height will be divided into 20 parts, the height of the coal space slope being divided into 10 equal parts. The 39 in. below the coal space slope is divided into eight parts, and the 12 in. above is divided into three parts. The spherical rear end is treated separately and added. The problem now is to get the area of the circular segmental strips and multiply them by their average lengths. From a table of areas of circular seg-

ments (see Kent, pages 121 and 122), the curve in Fig. 2 may be plotted. Only one-half of the complete curve is plotted, but by the use of two scales this may be made to serve for the complete circle. The scales at the left and bottom serve for segments less than a semi-circle, while those at the top and right are for those larger than a semi-circle. The areas read from this curve must be multiplied by the square of the diameter in inches, and the average length (in inches) of the portion of the tank considered. For the first eight points both the diameter and length are constants, the length being variable for the next 10 points. If the results are to be in gallons the above product must be divided by 231. The total segmental area is read from the curve in Fig. 2, and may be used direct for the first eight points since the other factors in the calculation are constant. For the remaining points, however, it is necessary to use the difference in the areas for successive points and calculate the increments of volume or capacity, adding the results

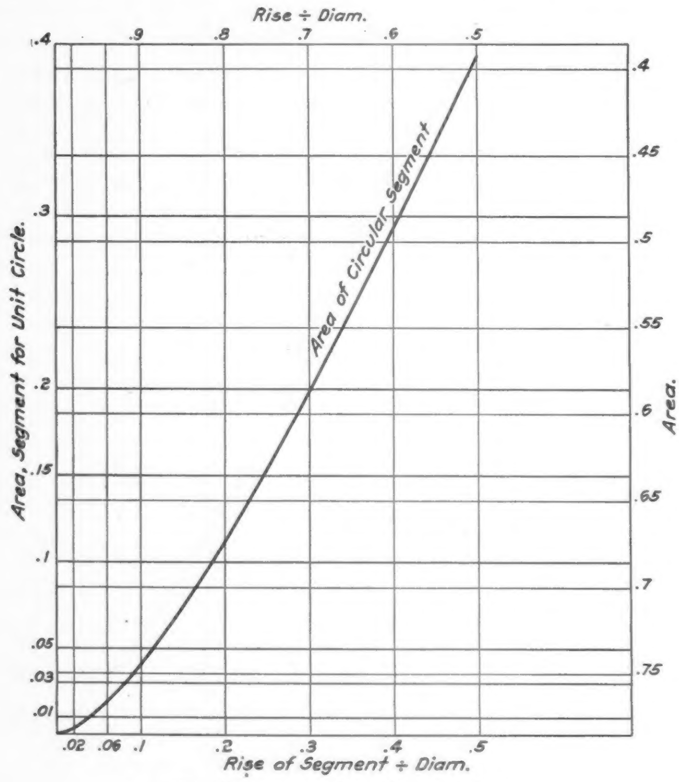


Fig. 2—Area of Circular Segments

to determine the total capacity for each point. The tabulation of the factors entering into the calculations is shown in Table I, these referring only to the cylindrical portion of the tank. The variable multipliers are in each case the average length of the strip in feet, the factor 12 being included in the constant multiplier:

Table I—Factors for Calibrating Cylindrical Portion of Tank Shown in Fig. 1.

Point No.	Area, Total	Area, Difference	Constant Multiplier	Variable Multiplier	Total Multiplier
1	.0147	....	....	...	11000
2	.0409	....	....	...	11000
3	.0739	....	....	...	11000
4	.1118	....	....	...	11000
5	.1536	....	....	...	11000
6	.1982	....	....	...	11000
7	.2450	....	....	...	11000
8	.2995	....	....	...	11000
9	.3460	.0465	478.7	19.6	9380
10	.3927	.0467	478.7	18.8	9000
11	.4394	.0467	478.7	18.0	8620
12	.4859	.0465	478.7	17.2	8230
13	.5318	.0459	478.7	16.4	78.50
14	.5755	.0437	478.7	15.6	7470
15	.6180	.0425	478.7	14.8	7080
16	.6580	.0400	478.7	14.0	6700
17	.6954	.0374	478.7	13.2	6320
18	.7290	.0336	478.7	12.4	5930
19	.7445	.0155	478.7	12.0	5750
20	.7707	.0262	478.7	12.0	5750
21	.7854	.0147	478.7	12.0	5750

For a formula to determine the volume of the portion of a spherical segment cut off by a plane at right angles to the base of the segment the writer is indebted to Professor Charles O. Gunther, of Stevens Institute. The formula is:

$$V = \frac{\pi a}{12}(a^2 - 3r^2) - \frac{b}{6}(3r^2 - b^2)\cos^{-1}\frac{a}{\sqrt{r^2 - b^2}} + \frac{ab}{3}\sqrt{r^2 - b^2 - a^2}$$
$$- \frac{a}{6}(a^2 - 3r^2)\sin^{-1}\frac{b}{\sqrt{r^2 - a^2}} + \frac{r^3}{3}\tan^{-1}\frac{r\sqrt{r^2 - b^2 - a^2}}{ab}$$

where

a = the perpendicular distance from the center of sphere to the base of the segment;
b = the perpendicular distance from the center of the sphere to the cutting plane at right angles to the base of the sphere;
V = ½ volume of the portion of the sphere cut off by the two planes.

To construct curves for general use, the tables shown for values of $\sqrt{r^2 - b^2}$, $\sqrt{r^2 - a^2}$, and $\sqrt{r^2 - a^2 - b^2}$ for $r = 100$, will be found very helpful.

Table II—Values of $\sqrt{r^2 - a^2}$ and $\sqrt{r^2 - b^2}$. r = 100

a	$\sqrt{r^2 - a^2}$	b	$\sqrt{r^2 - b^2}$
80	60.0	0	100.0
82	57.3	10	99.5
84	54.2	20	98.0
86	51.0	30	95.4
88	47.6	40	91.7
90	43.6	50	86.6
		60	80.0
		70	71.5
		80	60.0
		90	43.6

Table III—Values of $\sqrt{r^2 - b^2 - a^2}$. r = 100

b	a = 80	a = 82	a = 84	a = 86	a = 88	a = 90
0	60	57.3	54.2	51	47.5	43.6
10	59.2	56.4	53.3	50	46.4	42.4
20	56.6	53.7	50.4	46.9	43.0	38.7
30	52	48.8	45.2	41.3	36.8	31.6
40	44.8	41	36.6	31.6	25.5	17.3
43.6	....	....	....	....	....	0
47.6	....	....	....	....	0	....
50	33.2	27.9	21	10	....	....
51	....	....	....	0	....	....
54.2	....	....	0	....	....	....
57.3	....	0	....	....	....	....
60	0	....	....	....	....	....

It will be noted that for use in figuring spherical end capacity for either Vanderbilt tenders or oil car tanks, *a* will rarely have values outside of .8*r* to .9*r*, whereas, *b* will vary between 0 and $\sqrt{r^2 - a^2}$. A curve may be plotted between these limits and intermediate values may be interpolated. To convert results to

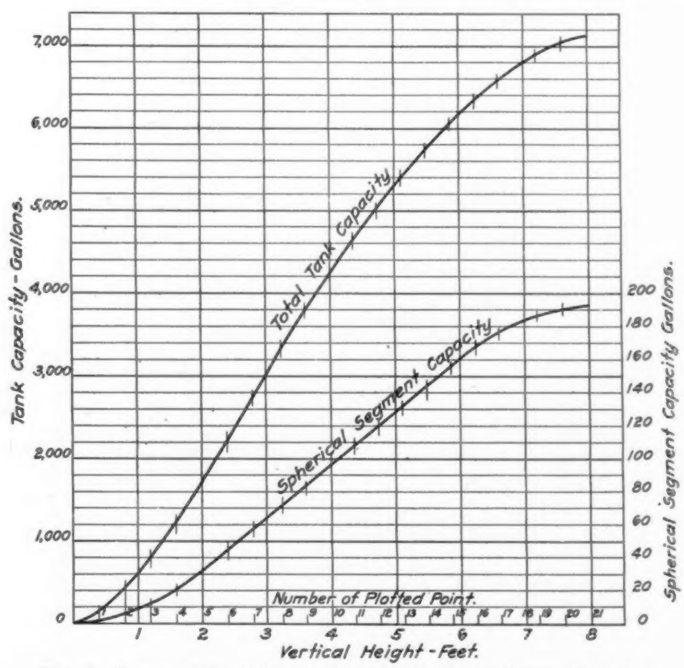


Fig. 3—Curve of Capacity for Vanderbilt Tank Shown in Fig. 1

gallons the readings taken from the curves should be multiplied by the cube of the radius of the sphere in inches and divided by 231,000,000.

In this manner were obtained the values for the capacity of the spherical end of the Vanderbilt tank, given in Table IV, and plotted in Fig. 3.

The third column of this table shows the results of the calculations indicated in Table I, and the last column gives the total capacity for each increment in depth of water, from which the total tank capacity curve in Fig. 3 is plotted.

Table IV—Capacity of Vanderbilt Tank

Point No.	Capacity Differences	Cylindrical capacity	Capacity of spherical end	Total tank capacity, gals.
1	...	162	2	164
2	...	450	6	456
3	...	813	12	825
4	...	1,224	21	1,245
5	...	1,690	33	1,723
6	...	2,180	46	2,226
7	...	2,696	58	2,754
8	...	3,296	72	3,368
9	436	3,732	84	3,816
10	420	4,152	97	4,249
11	403	4,555	109	4,664
12	383	4,938	121	5,059
13	360	5,290	133	5,423
14	327	5,617	145	5,762
15	301	5,918	157	6,075
16	258	6,176	168	6,344
17	236	6,412	178	6,590
18	199	6,611	184	6,795
19	89	6,700	187	6,887
20	156	6,856	191	7,047
21	85	6,941	193	7,134

These values, of course, are for a theoretical tank, as shown in Fig. 1, and make no allowance for baffle plates or for a rear end pocket to accommodate the draft gear. The baffle plates may be neglected, and if there is a draft gear pocket, it will have no effect on the net water readings unless the water in the tender is allowed to get extremely low.

RESULTS OF THE MASTER MECHANICS' ASSOCIATION LETTER BALLOT

Fifty-four subjects were submitted to the members of the American Railway Master Mechanics' Association for action by letter ballot, and of these only one was unfavorably acted on, that being the engineer's torch made of steel tubing and shown in the report of the Committee on Standardization of Tinware as Fig. 1. The entire 14 recommendations of the Committee on Standards and Recommended Practice were adopted, these including specifications for steel axles, firebox steel, forgings, cylinder castings, etc., and steel castings. The changes made in the specifications for inspection and testing of locomotive boilers to have them conform to the Federal regulations were adopted, as were the regulations covering the operation of brakes on engines and tenders handled dead in trains and offered in interchange.

The methods of photometering locomotive headlights, as proposed by the Committee on Locomotive Headlights, and the rules for determining stresses in longitudinal barrel seams and patches, longitudinal gusset braces and flat surfaces, and staybolts, radial stays and crown bar bolts in locomotive boilers as presented by the Committee on Design, Construction and Inspection of Locomotive Boilers, were also adopted.

Thirty-nine of the 40 examples of tinware presented by the Committee on Standardization of Tinware were adopted, which should prove of material assistance to the manufacturers and users of these articles. The instructions in fuel economy on locomotives, prepared by the Committee on Fuel Economy for the instruction of the enginemen and firemen were adopted, the vote lacking one of being unanimous. These instructions, it is understood, will be printed in pamphlet form and sold at a nominal cost by the association.

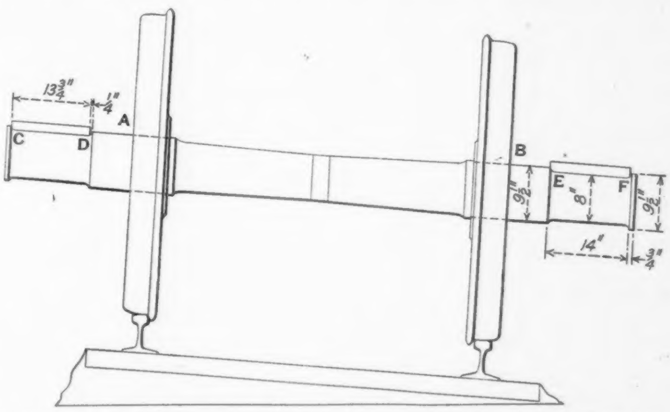
The three recommendations of the Committee on Forging Specifications covering the fiber stresses for heat treated and alloy-steel materials, and the specifications for quenched and tempered carbon steel axles and alloy-steel forgings (separate specifications) were adopted by a large majority. The rules outlined by the Committee on Boiler Washing for washing boilers were also adopted.

HOT TRAILER BEARINGS

BY G. W. A.

Hot trailer bearings are a source of much trouble to most motive power officials, as too frequently they occur on fast passenger trains, resulting in engine failures and annoying delays. The causes of hot boxes are either defective lubrication or excessive bearing pressure. Defective lubrication is induced by the following defects: (1) Waste improperly applied, (2) insufficient oil or oil of poor quality, and (3) too little waste or a poor quality of waste. Excessive bearing pressure may be due to (1) poor design, (2) improper application of the brass or (3) broken spring rigging.

Eternal vigilance is the only complete safeguard. In applying waste to the cellar care should be taken to see that it is long fibered, well saturated with oil, preferably coach oil, and so worked into the cellar as to present a uniform mass of intertwined fibers. If the axle has a collar, the waste should be packed so that it will not be tight against the collar, as the latter acts as a wiper, glazing the surface and forming a productive source of future overheating. On one large system in an effort to eliminate hot trailer bearings a very rigid system of inspection is practiced in the roundhouse. A record is kept of each engine and every four days the cellar is taken down,



Ends of Trailer Brases in Contact with Shoulders When Curving

the waste worked over, a slight amount of fresh dope added and the box oiled, or the whole renewed as the case may be. Notwithstanding this care, however, hot trailer bearings are of too frequent occurrence, which leads to the belief that they arise from other causes.

The sketch shows the type of journal and brass on a class of Pacific type locomotive used in both passenger and fast freight service. This trailer is of the radial type, using a roller bearing plate for the spring seat. The total wheel load carried is 40,500 lb., of which about 4,500 lb. represents the weight of the wheels and axle, leaving 36,000 lb. to be distributed between the two journals. This gives a bearing pressure of 191 lb. per sq. in. of projected area, well within the limit of safe practice. The axle used is of the collar type, and to this it is believed can be attributed in many cases the beginning of heating. It has been noted in a number of instances that heating is first observed about the collar, and when discovered in time may be checked. While not accessible, it is also believed that the shoulder adjoining the wheel seat acts in the same manner, but owing to the larger body of metal in close proximity, more heat is conducted away, and the bearing is therefore heated less rapidly. Signs of heating and of cutting are in practically all cases found on both the fillet of the collar and the shoulder at the rear end where bearings have been overheated. The distance between the collar and shoulder of the axle is 14 in., and the length of the brass is 13¾ in., giving a clearance of ¼ in. When in the shop, or when new hub liners are applied, the trailer is fitted up with a total lateral motion

of ¼ in. Assume now, that the engine is rounding a curve as shown in the sketch. Pressure is exerted against the wheel flange, tending to throw the hub face *B* in contact with the liner on the truck box. With ¼ in. total side play, this motion will only amount to ⅛ in., still giving ⅛ in. clearance between collar or shoulder and the end of the brass. When, however, the lateral has worn to a total of ½ in., the side movement induced in rounding the curve will not only cause contact with the box and hub at *B*, but also between the journals and brasses at *E* and *C*. From this time on, as side play develops the box and brass will both wear. If now, the lubrication at any time is momentarily impaired, or the waste around the collar has become glazed, the fillets will tend to cut and heat the ends of the brasses against which they are thrown in rounding curves. Should the brass for any reason be renewed after a total side play of more than ½ in. has developed, the above condition is greatly aggravated. In this case the side play for the brass is only ¼ in., and the thrust in turning the trailer must be carried by the small fillet bearing on the end of the brass instead of by the liner.

The force exerted on a trailer in rounding a curve may be considered as the centrifugal force acting on the load carried by the truck and the frictional resistance between the wheel and the rail. The centrifugal force is resisted by the hub face on the low side of the curve, by the frictional resistance in the spring roller plates or step bearings and by the centering springs. For purpose of illustration let us assume that the engine is rounding a 2 deg. curve at 50 miles per hour, and consider only the centrifugal force acting on the truck:

$$\text{Centrifugal force} = \frac{40{,}500 \times 73.4^2}{32.16 \times 2{,}865} = 2{,}364 \text{ lb.}$$

The area of the hub plate is 148.814 sq. in., while the projected area on the end of brass is 6.872 sq. in. The bearing pressure produced on the hub plate is $\frac{2{,}364}{148.814} = 15.92$ lb. per sq. in., while that produced on the ends of the two brasses is $\frac{2{,}364}{2 \times 6.872} = 172$ lb. per sq. in.

It will thus be seen that it is entirely possible to have an excessive collar bearing pressure, which in conjunction with defective lubrication at this point, may be a source of overheating. It is the writer's belief that the collars should be abandoned and the shoulders so located as to insure ample clearance between them and the ends of the brasses at all times.

ABATEMENT OF LOCOMOTIVE SMOKE IN CINCINNATI*

BY G. H. FUNK

General Smoke Inspector, Cincinnati Railway Smoke Inspection Bureau

The elimination of smoke in the city of Cincinnati is an especially difficult proposition, as that part of the city where many of the yards are located and the greatest congestion occurs lays in a valley; climatic conditions are also such that the smoke nuisance is considerably aggravated. In several instances there are heavy grades just outside the depot or yards, which require the locomotives to be operated to their full capacity. One road has an ascending grade of 3½ per cent for 1½ miles from the start. In order successfully to combat the smoke under these conditions it is necessary that the locomotives be in good condition, properly equipped with adequate smoke consuming devices, and most of all, that the engine crews be well trained in their respective duties.

In July, 1913, the railroads took concerted action to combat the smoke problem and organized the Railway Smoke Inspection Bureau. The inspectors attached to this bureau are responsible only to the bureau, and make impartial observations of all locomotives coming within their notice, reporting the results to the general inspectors. All violations are reported daily to the officer of the road on which they are made, and weekly reports are made to each road showing the total number of engines observed, the number of violations and the comparison with the previous week. The inspectors do not confine themselves to making observations, but make it a point to ride with the offending engine crews at the first opportunity to find out what is wrong. They are able as practical engine men to instruct the crews in the proper method of handling the locomotives. Where the engine is found at fault a report is made to the proper official at once. At certain intervals the inspectors ride every engine and with every crew at the terminal, and repeat the instructions, demonstrating by actual operation what can be accomplished.

By reporting the condition of the engine, as well as the smoke violation, there has been a noticeable improvement in the condition of the locomotives. Monthly meetings are held with the master mechanic, general foreman, road foreman of engines and others interested. The subjects discussed are diversified, extending from drafting of engines to the chemistry of combustion. The meetings have been found to be of great value.

Some roads have distributed instruction books to their men on the elements of combustion of fuel, covering the ground sufficiently to show how smokeless firing may be obtained, and the economy in fuel that will result. The engineers are not neglected. They are instructed as to the proper methods of operating the locomotives and are required promptly to report all defects, such as blows, plugged flues, leaky joints, or any other cause that may make the engine steam badly. As most of the roads use a high volatile bituminous coal, it was found necessary to equip the locomotives with some device to assist in the abatement of the smoke. The induction air tubes, brick arches, double or multiple tip blowers, and openings in the firebox have been adopted as standard, producing excellent results. Attention has been given to the admission of the air through the ash pans and grates, and on many engines that formerly had tight ash pans, the pans have been dropped from 3 in. to 5 in. from the mud ring, the openings being covered with screens. Most of the roads have found it possible to enlarge the nozzles without effecting the steaming of the engine. By doing this the back pressure in the cylinder has been reduced and a milder draft is obtained, which permits the fireman to keep the fire thinner; the tendency towards the formation of holes, due to excessive draft, has also been reduced. One road has increased the size of nozzles from 4⅞ in. to 5¾ in., resulting in a fuel saving of 17 lb. per engine mile.

Before the locomotive leaves the engine house territory the fire is supplied with sufficient fuel, admitted in small quantities to avoid smoke, until there is a moderately heavy bed of coked coal over the entire grate surface. In switching service not more than two scoops can be fired at a time. In freight pusher service the charges are limited to three scoops at a time; in light passenger service two scoops is the limit, and in heavy service, three scoops. The engine crews are instructed to bring their engines to the ash pit with no green coal in the firebox and with a well-burned fire.

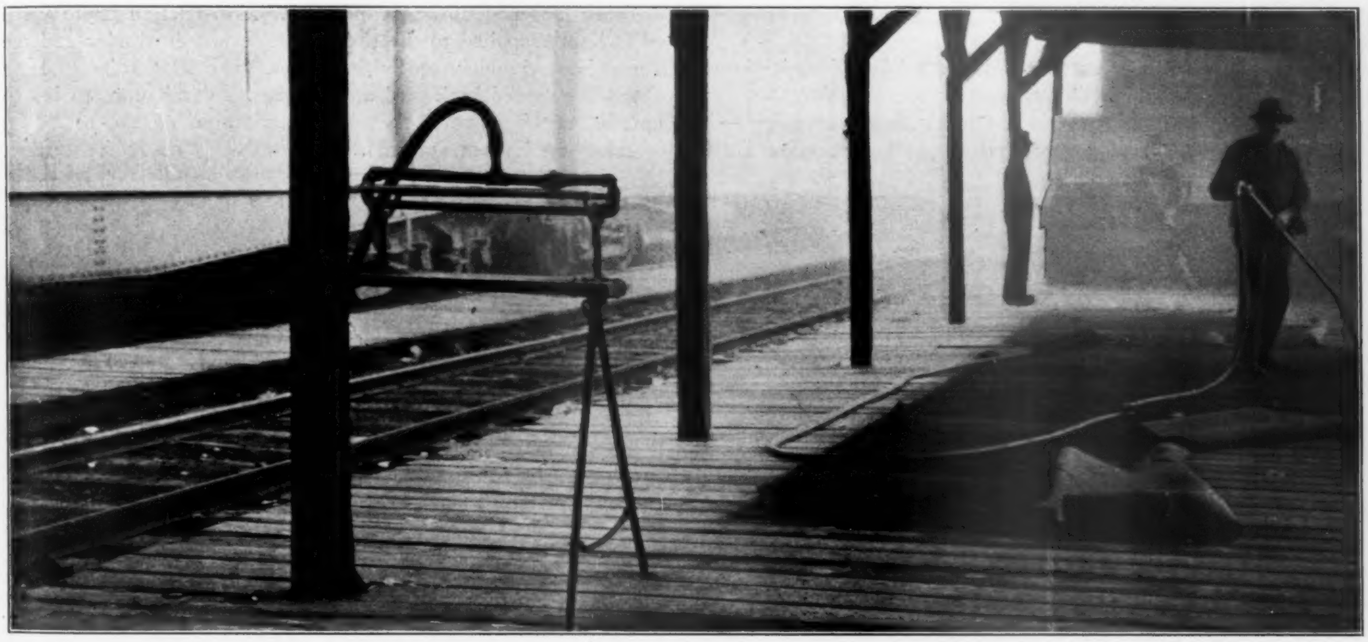
The Railway Inspection Bureau averages from 750 to 800 observations per week. The average smoke density has been decreased from 30.8 per cent in November, 1913, to 15.4 per cent in August, 1915. In addition to the excellent results from reducing the smoke there has been found to be an improvement in the fuel economy. One road with the side induction tubes, the long arch and the larger nozzles on its locomotives, has been able to show a saving of 102 lb. of coal per engine hour, and a superintendent on another road claims a saving of 13 per cent in fuel. The greatest factor, however, in any smoke abatement campaign is the engine crew, and it will be found that a good fireman on a poorly equipped locomotive will produce less smoke than a poor fireman with all the latest appliances.

*Abstract of a paper presented before the tenth annual convention of the International Association for the Prevention of Smoke.

CAR DEPARTMENT

CLEANING CARPETS AT TERMINALS

The method of cleaning carpets at the car yards of the Chicago & Western Indiana, a terminal company at Chicago, is shown in the illustration. Compressed air is used. The arrangement shown at the left is for cleaning or blowing the dirt out of the aisle strips. It consists of two guide rods and a pipe with perforations on its under side. The carpet is passed over one guide rod, under the perforated pipe and out over the other guide rod. The arrangement is simple and cleans the aisle strips thoroughly. The method of cleaning the larger pieces of carpet is shown at the right. Air from the short line is used in both cases, the water being thoroughly blown out of the apparatus and pipes before using.



Apparatus Used for Cleaning Carpets by Compressed Air on the Chicago & Western Indiana

RESULT OF M. C. B. LETTER BALLOT

Of the 91 subjects submitted to the members of the M. C. B. Association for adoption by letter ballot only five were rejected. Of those rejected the specification describing the door of wooden construction and the question as to whether or not standards should be established for limiting dimensions for the cast steel design of truck side frames, with pedestal jaws and designs of journal boxes for them, were the most notable. The Committee on Brake Beams succeeded this year in providing a specification for testing all classes of brake beams that was adopted by a large majority. The adoption of the recommendation of the Committee on Train Brake and Signal Equipment, that truck clasp brakes be applied to all four-wheel truck passenger cars weighing 96,000 lb., or over, and to all six-wheel truck passenger cars weighing over 136,000 lb., is indicative of the success of this type of brake.

The rules governing the minimum strength requirements for reinforcement of the draft gear of existing wooden cars, as formulated by the Committee on Car Construction was adopted with a large majority, and, if carefully followed, will be of material benefit to the railroads. The entire recommendations of the Committee on Specifications and Tests for Materials were adopted. The work of the Committee on Train Lighting was approved, with the exception of the recommendation regarding the use of emergency fuses between the dynamo and field on wooden cars equipped with axle dynamos. The Committee on Car Trucks, acting on the suggestion of those roads which voted negatively on the subjects submitted to letter ballot at the 1914 convention, has succeeded in reconstructing its recommendations so that 17 of the 18 subjects presented this year were approved.

Following is a list of the subjects voted on:

Standards and Recommended Practice:	
Hole in wedges for removal by use of packing hook. (Standard)	Adopted
Lining for outside framed cars	Adopted
Springs and spring caps for trucks. (Standard)	Adopted
Classification of cars	Adopted
Height of platform buffer for passenger cars	Rejected
Postal car specifications and floor plans	Adopted
Insulator tests	Adopted
Uncoupling arrangements for passenger car couplers	Adopted
Omission of arc recess in wedges	Adopted
Train Brake and Signal Equipment:	
Conductor's valve	Rejected
Truck clasp brakes	Adopted
Hose coupling gasket gage	Adopted
Brake Shoe and Brake Beam Equipment:	
Specifications and tests for brake beams	Adopted
Loading Rules:	
Rules 4, 12C, 15A, 15B, 15F, 24, 93, 98, 98B, 120, 121B, 124, 124A, 126, and 130	Adopted
Car Construction:	
Specifications for side doors for new cars. Paragraph 4a)	Rejected
Specifications for side doors for new cars. (Par. 4b to 4n, inclusive)	Adopted
Draft gear. Par. 6a to 6d, inclusive)	Adopted
Shearing value of steel	Adopted
Specifications for Tests of Materials:	
Changes in chain specifications	Adopted
Changes in coupler specifications	Adopted
Changes in steam heat hose specifications	Adopted
Changes in air brake hose specifications	Adopted
Specifications for structural steel, etc. (passenger cars)	Adopted
Specifications for structural steel, etc. (freight cars)	Adopted
Specifications for malleable iron	Adopted
Specifications for miscellaneous steel castings	Adopted
Specifications for journal bearings	Adopted
Specifications for mild steel bars	Adopted
Specifications for rivet steel and rivets	Adopted

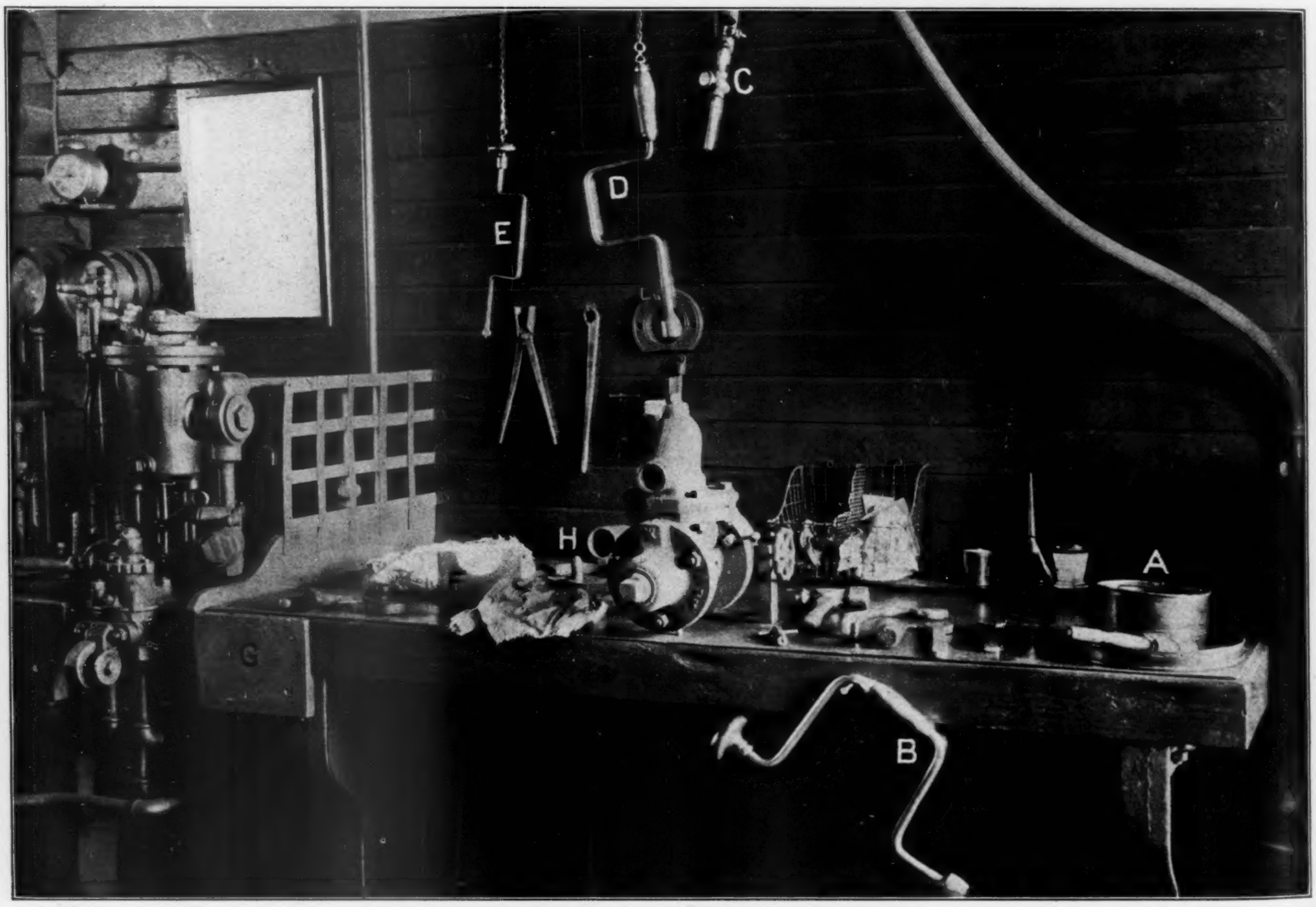
Specifications for galvanized sheets	Adopted
Train Lighting:	
Dynamo fuses on wooden cars	Rejected
Minimum dimensions for battery boxes	Adopted
Armature pulley	Adopted
Armature shaft end	Adopted
Pulley taper fit	Adopted
Ball bearing size	Adopted
Conduits	Adopted
Solid face generator pulley	Adopted
Car Trucks:	
Specifications and tests for cast steel truck sides	Adopted
Specifications and tests for pressed steel bolsters	Adopted
Variations in weights of truck sides	Adopted
Rejection of cast steel truck sides	Adopted
Design of cast steel bolsters. (Exhibits C to H, inclusive)	Adopted
Design of pressed steel bolsters. (Exhibits I, J, and K)	Adopted
Limiting weights for cast steel bolsters	Adopted
Limiting weights for pressed steel bolsters	Adopted
Spread of side bearings	Adopted
Center plates	Adopted
Truck sides with pedestal type jaws	Rejected

A more detailed account of the propositions submitted to the members in this letter ballot may be found under the reports of the respective committees which were abstracted in the *Daily Railway Age Gazette* of June 10, 11, and 12, 1915.

CLEANING TRIPLE VALVES

A convenient arrangement for cleaning triple valves is shown in the photograph, which illustrates a bench used for this purpose at the Chicago, Burlington & Quincy shops, Lincoln, Neb. The work is done on a piece-work basis and the arrangement was planned by the men doing the work. The valve, which in this case is a Westinghouse H triple, is first placed in the holder as shown. The cylinder cap nuts are touched up with kerosene oil with the brush shown at A, the oil being contained in the can, and the nuts are removed with the brace *B*. The cylinder cap is then removed and blown out with the air hose *C*. The main piston and slide valve are removed and the piston dipped in kerosene oil in the can *A* and allowed to drain. The check case is then removed, the brace *D* being used for this purpose. The emergency valve is removed and placed in the basket *K*. The valve body is then blown out with the air hose *C*. The gasket is removed and the seat scraped. The body is swabbed out with kerosene and wiped dry. The emergency piston is blown out and carefully wiped, its seat being slightly ground on the sandpaper at *G*. The emergency piston and valves are then replaced after the rubber seat of the valve has been smoothed off by sandpaper and replaced. The check valve case is then placed in the rest *F* and the check valve is ground to a seat with the brace *E*, the pumice and oil mixture being already prepared at *I*. It is then carefully wiped out with a cloth. The check case is placed over the nozzle *H*, the pipe opening being inserted in the pipe there shown and blown out. Air for this purpose is controlled by a pedal valve under the bench. The check case with the check valve is then replaced.

The main piston which has been draining at the can *A* is then cleaned, the oil being blown out from under the packing ring, the ring loosened up and wiped dry. Anti-friction triple valve oil is lightly applied to the slide valve seat, the cylinder and the head of the cylinder cap by the finger. The slide valve and the piston are moved backward and forward several times to insure smooth working and a thorough distribution of the oil. The cylinder cap is then applied and the valve is ready for testing. With these conveniences it is possible to clean a triple valve in from six to seven minutes.



Arrangement of Bench for Cleaning Triple Valves

SWEDISH IRON IMPORTS.—Swedish imports of pig iron were only 35,660 tons for the first six months of 1915, compared with 47,894 tons in the same period in 1914.—*The Iron Age.*

FOUR WHEEL TRUCKS FOR PASSENGER CARS*

Discussion of Fundamental Factors of Design and the Ability of This Type of Truck to Meet Them

BY ROY V. WRIGHT

The Pennsylvania Railroad uses four-wheel trucks under all of its passenger coaches, although the P 70 class, 70 ft. in length and having a seating capacity of 88, weigh light from 118,000 to 122,000 lb. Loaded with passengers they weigh about 135,000 lb., and never more than 140,000 lb. It is the standard practice on that system to use such trucks under all passenger equipment cars weighing less than 120,000 to 125,000 lb., except for so-called load-carrying cars, including baggage-express, mail, baggage-mail, etc., which are designed to weigh over 140,000 lb. when loaded. The light weight of the bodies of the Pennsylvania P 70 coaches—and these are now standard on that system—varies from 93,000 to 96,000 lb. It is assumed that these cars regularly carry as much weight in passengers and hand baggage as coaches on other roads, inasmuch as they seat 88 persons, or several more than the maximum provided for in the standard coaches of most roads. It is the practice on the great majority of railroads to use six-wheel trucks under coach bodies weighing much less than this, comparatively few roads using four-wheel trucks under bodies weighing more than 85,000 lb. and many of them using six-wheel trucks under bodies weighing even less than this.

FACTORS IN DESIGN

In designing the trucks for a passenger coach four features must be kept in mind and generally in the following order as to importance, although there may be some question as to the relative value of the last two:

(1) They must be designed for safety.

(2) They must ride smoothly, for travelers are particular as to this in these days and will desert a road with rough-riding cars if a competitor furnishes better service. With heavy steel cars operated in long trains at high speed and with the locomotives taxed to the limit of their capacity it is difficult to operate and brake the trains without occasional roughness and jolts, and a factor such as truck design cannot be allowed to contribute further to the rough riding.

(3) The weight of the truck must be kept to a minimum if for no other reason than the effect on the cost of conducting transportation.

(4) The truck should be designed with a view to keeping the cost of maintenance as low as possible. Here, as in the requirement for safety, it is desirable to have as few parts as possible and of simple construction.

DOES THE FOUR-WHEEL TRUCK MEET THESE REQUIREMENTS?

How does the four-wheel truck meet these requirements under the heavy passenger equipment in service on the Pennsylvania Railroad?

(1) The four-wheel truck of modern steel construction which has been in use on that system for a number of years has given splendid satisfaction so far as safety is concerned. As on other roads some trouble has been experienced with hot boxes, and it was at first thought that the journal-bearing area was too small. The use of larger bearing areas does not seem to have materially improved conditions, and it is now believed that the difficulty is entirely due to dirt or gritty matter entering the journal boxes. The problem then becomes one of improving the journal box lid and dust guard to prevent this, rather than to increase the diameter or length of the journals.

There has been no breakage of axles except for three cases due to defective material when the first steel trucks were introduced many years ago. No physical weakness has developed in any of the parts in the ten years the trucks have been in service, so that as far as safety is concerned there can be no question. The possibility of accident would seem to be less with the four-wheel truck because of the smaller number of parts that are required.

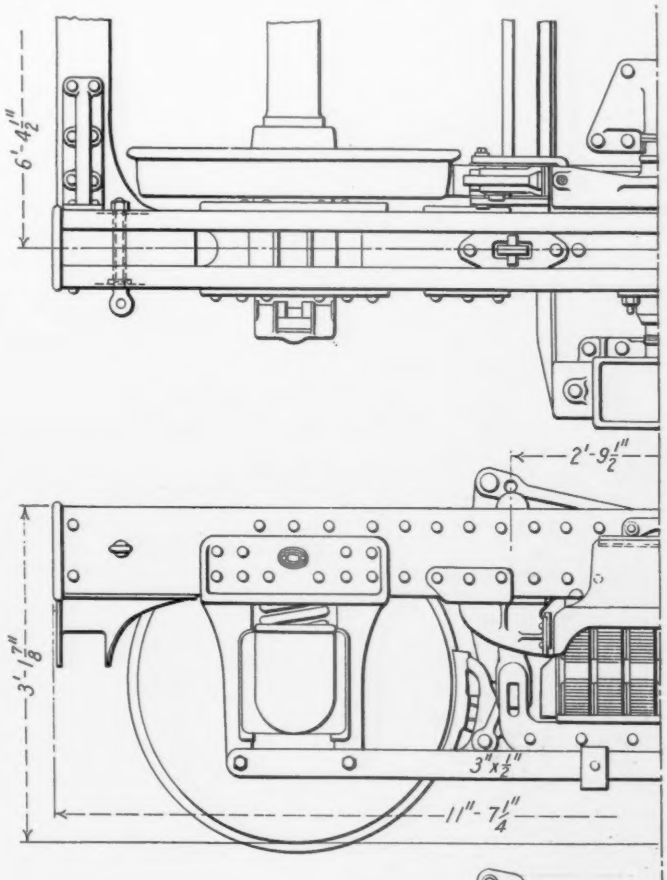


Fig. 1—One End of Original Four-Wheel Steel Passenger Car Truck Before the Application of the Clasp Brakes; Pennsylvania Railroad

(2) There seems to be a feeling on the part of some mechanical engineers that the four-wheel truck, with its shorter wheel base (7 or 8 ft. as compared with 10 to 11 ft. for the six-wheel truck) will ride less easily than the six-wheel truck. With coil springs over the journals, elliptical springs under the

*A paper to be presented before the December, 1915, meeting of the American Society of Mechanical Engineers, New York.

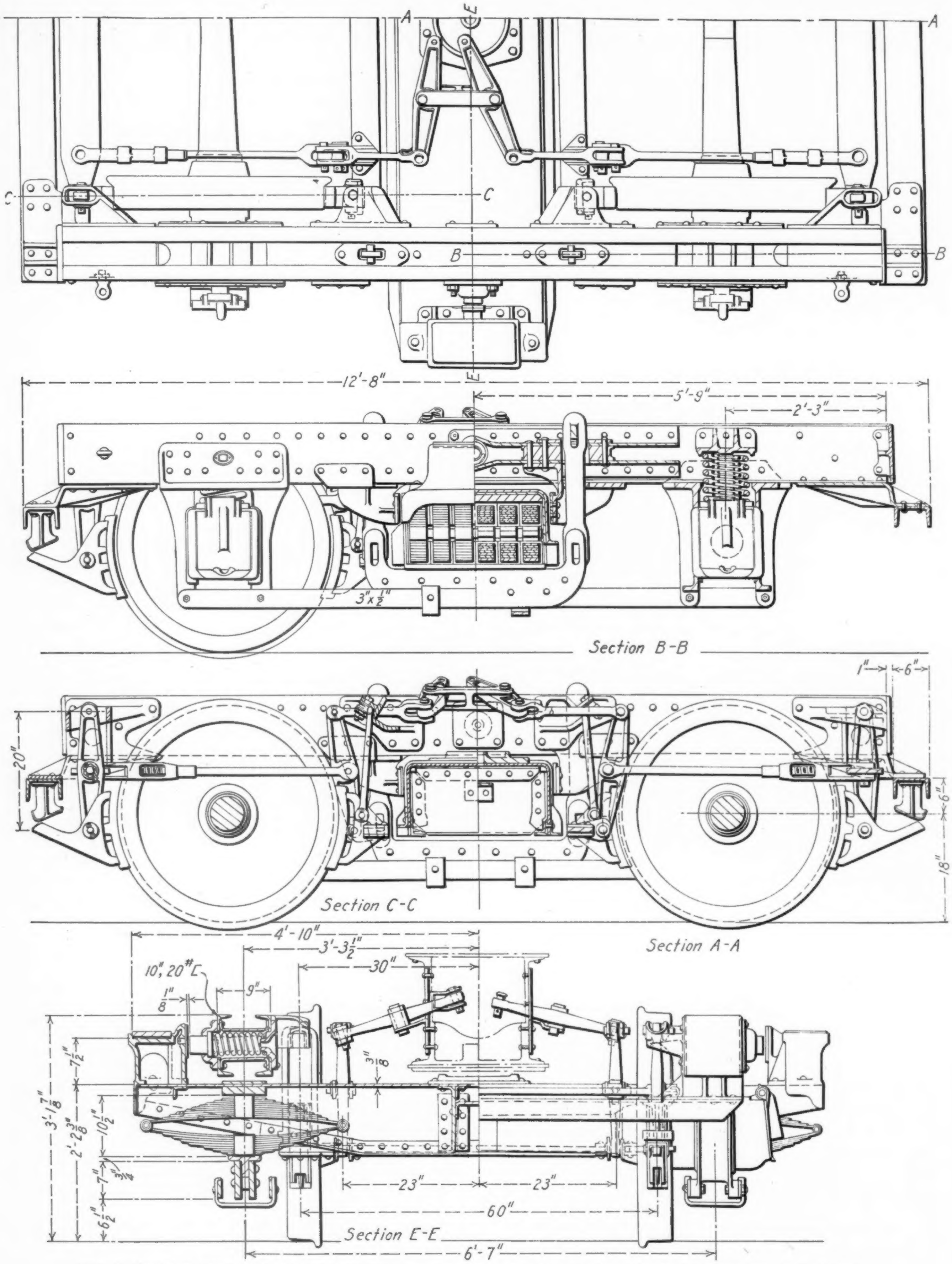


Fig. 2—Original Four-Wheel Steel Passenger Car Truck with Clasp Brakes Applied; Pennsylvania Railroad

bolster, and provision for lateral motion of the bolster, it would seem that there ought not to be much difference in this respect.

Experiments show that much of the rough riding or jolting on passenger coaches has been due to the method of anchoring the top of the dead lever to the truck frame. The unbalanced forces in the truck when the brakes are applied tend to tilt the truck frame out of horizontal alinement, thus causing a "jerky" action. By anchoring the dead lever to the body under-

frame this is eliminated. This development is comparatively recent and affects the six-wheel as well as the four-wheel truck. The effect of anchoring the dead lever to the truck frame has possibly been more noticeable on the four-wheel truck, because one to one dead levers are used, resulting in a greater pull on the frame than in the case of the six-wheel truck; then, too, the resisting moment is less because of the shorter wheel base of the four-wheel truck. This improvement has been patented.

(3) There is a wide variation in the weights of different types of steel passenger car trucks, but it is probably fair to state that a pair of four-wheel trucks will weigh from 10,000 to 15,000 lb., or more, less than a pair of six-wheel trucks having the same carrying capacity. In other words, for the same total weight of car the one with four-wheel trucks will carry ten to fifteen thousand pounds more lading or body weight, or with the same weight of body the total weight of the car with four-

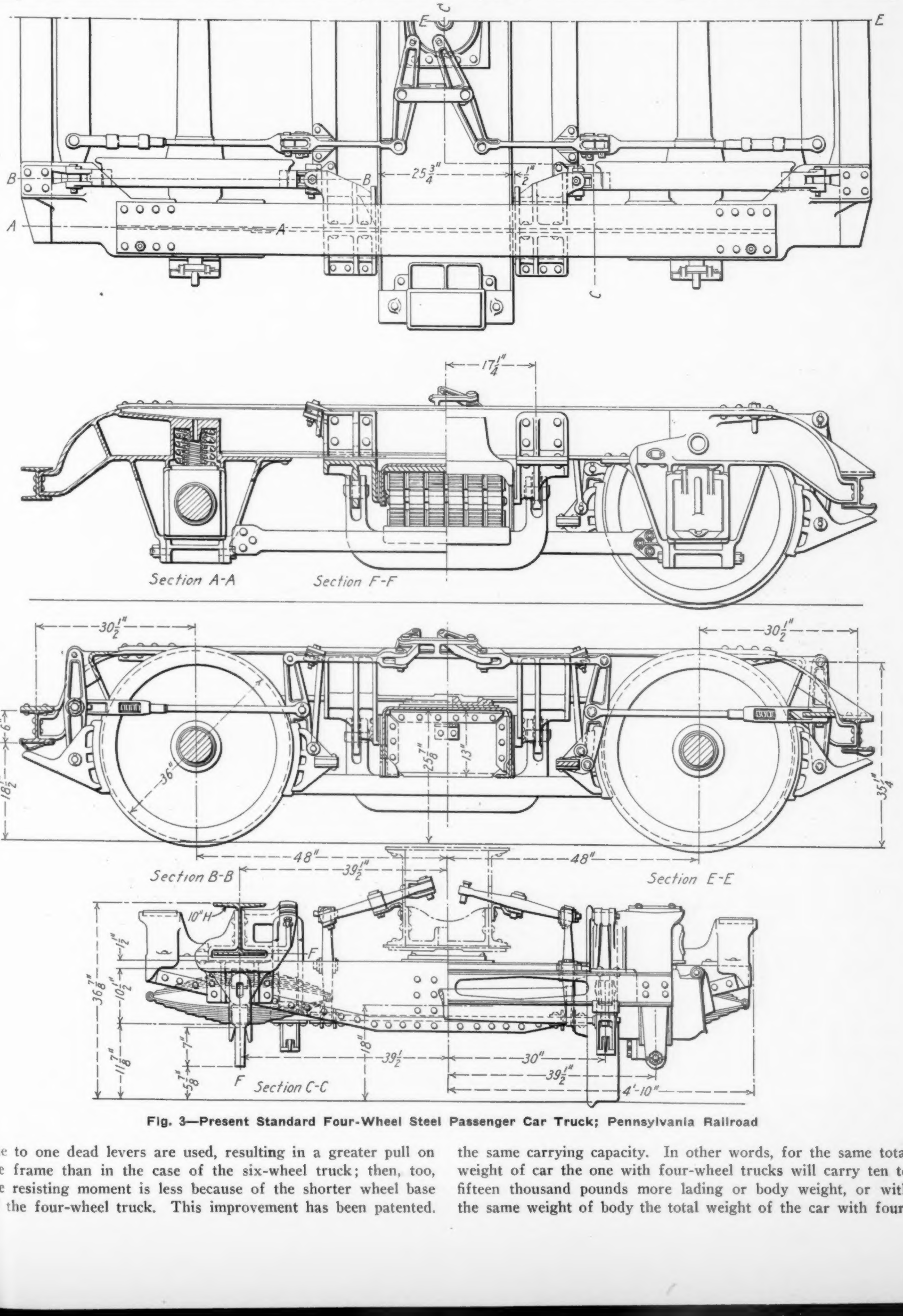


Fig. 3—Present Standard Four-Wheel Steel Passenger Car Truck; Pennsylvania Railroad

wheel trucks will be from 10,000 to 15,000 lb. less than the one with six-wheel trucks. For a car weighing 120,000 lb. and equipped with four-wheel trucks this means a saving of from 8 to 11 per cent in total weight as compared with what it would be if six-wheel trucks were used. On most roads it is the practice to carry car bodies weighing more than 85,000 lb. on six-wheel trucks, which weigh fuly 15,000 lb. per car more than four-wheel trucks. A locomotive that can haul eight cars equipped with such six-wheel trucks over a given division will haul nine cars of the same seating capacity having four-wheel trucks—a saving much to be desired.

(4) Roughly speaking, the cost of maintenance of a steel passenger car truck may be said to be very nearly in proportion to the number of its wheels and axles, these with the brake shoes being the parts subjected to the greatest wear and requiring frequent repairs and renewals. While no exhaustive data is available as to the comparative cost of repairs and maintenance of six-wheel and four-wheel trucks of the same carrying capacity, they are said by those who have checked these costs to be at least 50 per cent greater for the six-wheel truck than for the four-wheel truck.

DEVELOPMENT OF PENNSYLVANIA FOUR-WHEEL TRUCK

As a partial check on these conclusions, it is proposed to briefly review the development of the four-wheel steel truck for passenger cars on the Pennsylvania Railroad. From the outset and throughout this development the aim has been to reduce the number of parts to a minimum and make the construction as simple as possible. The problem has been complicated somewhat by the necessity of providing for the application of motors to the trucks used under motor cars in electrified districts and also by the application within the past few years of the clasp brakes, which are now standard on the Pennsylvania for all four-wheel trucks and for all new passenger equipment trucks.

In designing the first four-wheel steel trucks in the early part of 1905 it was aimed to use them under the largest coach possible and keep within the M. C. B load limits for 5-in. x 9-in. axles. Shortly after the trucks had been placed in service three of the axles broke in the wheel seat, where the stress is least. Investigation finally showed that the breakage was due to defects in manufacturing caused by a faulty furnace which had been discarded shortly after these axles were made. In the meantime, however, as a measure of absolute safety, it was decided to increase the axles on existing cars ½ in. in diameter and on new cars go to the next larger size standard M. C. B. axle, the 5½-in. x 10-in. Because of hot box troubles the length of journal was afterward increased in 11 in., although experience has since indicated, as previously noted, that the trouble was probably due more to dirt getting into the journal box than the lack of journal bearing area. The 5½-in. x 11-in. journal is now standard for all four-wheel as well as six-wheel trucks.

In going from the wood to the steel construction spring planks, axle guards and brake beams were done away with, the brake levers being attached directly to the brake heads. Each side frame was formed of two 10-in. 20-lb. channels, with the flanges turned inward and forming a box girder construction. The channels were spaced so as to measure 9 in. over-all. This was done to provide sufficient strength for resisting the lateral stresses, a requirement which has been overlooked in some designs. To check or limit the lateral motion or swaying of the bolster a spring arrangement was used, as shown in the drawing.

The subsequent use of clasp brakes made it necessary to modify this design somewhat. Fig. 2 shows the details of this modified design, which in general is practically the same as the original design, other than the braking arrangement, except for changes in the end construction of the frame to provide for the outside brakes. The detail of the original end construction is shown in Fig. 1. The end rail in the original design, which was formed of a ⅜-in. plate pressed in the form of an inverted U, 6 in. in width, was changed to make room for the brake levers. The outside brakeheads in the case of the clasp brakes are attached to the lower ends of the brake levers, which are anchored at the top to castings riveted to the ends of the side frames. A 6-in. channel with flanges turned downward connects these castings and forms the end rail. It was also necessary to add brakehead tie bars because of the impossibility of connecting the tension rods for the outer brakeheads direct to the brake lever. It should be noted, however, that this brakehead tie bar is a simple rectangular bar and that the brake tension rod connects to it as close to the brakehead as possible. Obviously the weight and the cost of maintenance of this tie bar is much less than for a breakbeam where the force is applied at the middle. All of the brake levers, including both the dead and live levers, are made the same size and are interchangeable except for the drilling.

The peculiar form of the outer brakehead is noticeable. In the first application of the clasp brakes the ordinary type of brakehead was used with springs to hold it balanced when hanging loose. These springs were difficult to maintain and were done away with by redesigning the brakehead and adding the tail piece. When the brakehead hangs loose this tail piece rests against a casting which is riveted to the underside of the end rail. When the brake is applied there is a clearance of ½ in. between the brakehead tail piece and the rest. This device has given most satisfactory results.

The next development was a modification of this design to provide for the application of a motor for use under motor cars on electrified divisions. To do this it was found necessary to increase the wheel base from 7 ft. to 8 ft. 6 in. Transoms were also added to support the lip of the motor and the bolster design was modified slightly; otherwise the same parts were used as in the original design.

The next development was a radical one, the box girder sideframe being replaced by a Bethlehem 10-in. 54-lb. H-beam, thus simplifying the design as to construction by reducing the number of parts and still providing sufficient moment to resist the side stresses. As shown in Fig. 3, the journal box pedestal casting has a projection to which the top of the lever for the outside brake is anchored and which also supports the end rail, a 6-in. H-beam. The H-beam which forms the side frame has its lower flange and web cut away over part of the journal box pedestal casting and is strongly riveted to it through both the upper and lower flanges. The casting which was formerly used on the end rail to balance the brakehead was replaced by a steel clip which is sprung over and welded to the lower flanges of the end rail.

Another noticeable change was the shortening of the bolster hangers, thus limiting the amount of side swing and making it possible to do away with the complicated spring mechanism which was formerly used to check and limit the lateral motion of the bolster with the longer hangers. Before making this change the springs were gradually blocked and finally wedged solid on a number of the cars. As this had no noticeable effect on the smooth riding, it was decided to discard the springs entirely.

The more important of these changes, that is, the side frame construction and the change in the hanging of the bolster, were first made on four-wheel trucks for suburban cars, several hundred of which were built. These trucks, however, were of lighter construction than those used under the standard coaches and will not be considered in this discussion. The details of this improved truck as designed for use under standard coaches are shown in Fig. 3.

A modification of this standard truck was made necessary by the Philadelphia-Paoli electrification and is shown in Fig. 4. The most powerful motors thus far used under passenger

coaches are required in this service, 225 horsepower each. To provide for them it was necessary to extend the wheel base of the truck from 8 ft. to 8 ft. 8 in. Because of the great amount of room required by the motors, blower apparatus, etc., it was necessary to do away with the brakehead tie-bars, or brakebeams, and to arrange the tension rods for the outside brakeheads to straddle the wheel as shown in the drawing. This application also made it possible to change the construction at the ends and the gear wheel, which meshes with the motor pinion, is now fastened to the axle rather than on the projection of the wheel hub.

It is necessary to provide a blower apparatus to cool the large motors which are used. The blowers are fastened to the underframe of the body of the car near the center and the draft is carried through a duct formed by the box-shaped center girder of the car between this point and the bolster.

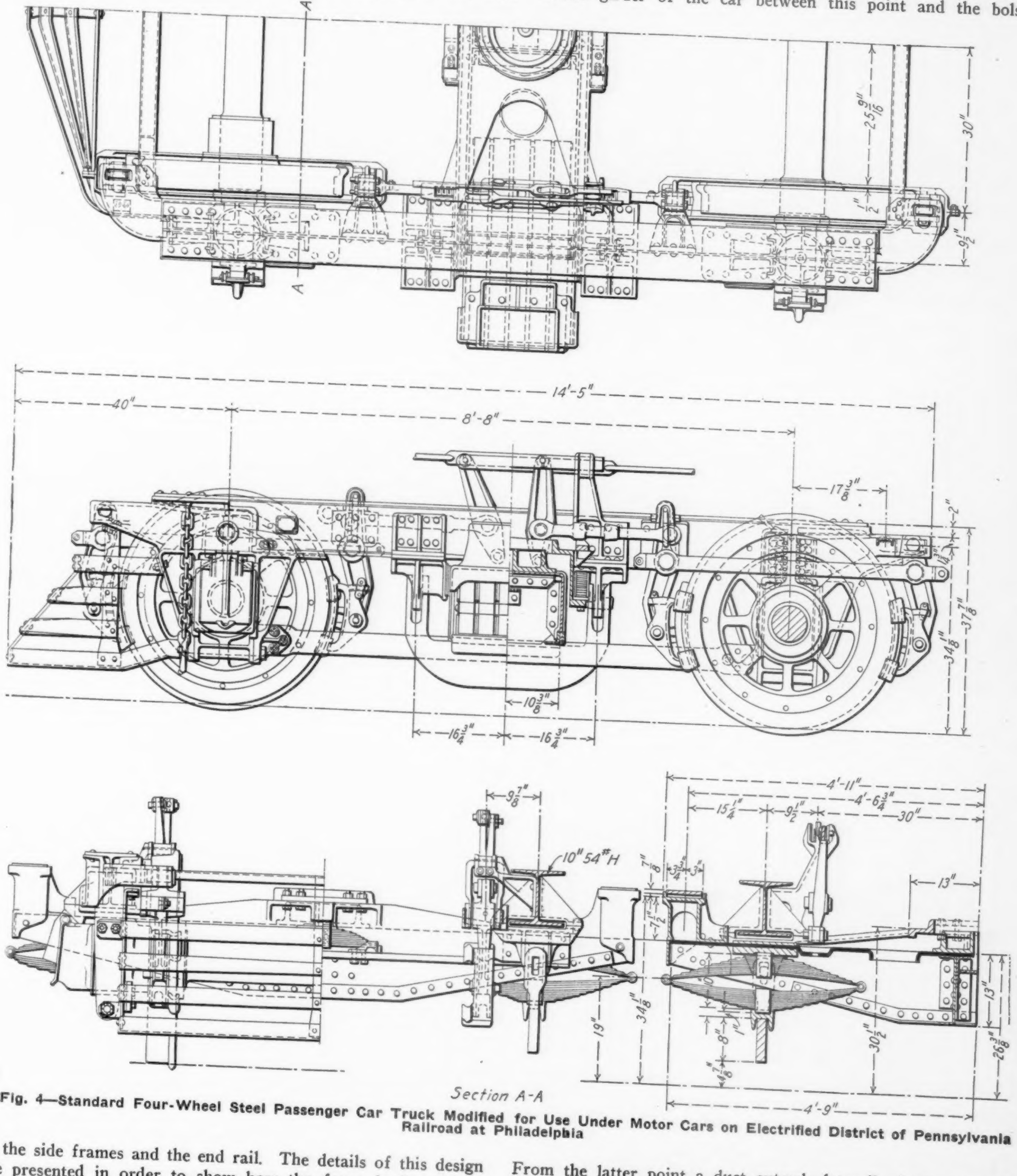


Fig. 4—Standard Four-Wheel Steel Passenger Car Truck Modified for Use Under Motor Cars on Electrified District of Pennsylvania Railroad at Philadelphia

of the side frames and the end rail. The details of this design are presented in order to show how the four-wheel standard truck for use under heavy coaches could be preserved in its general features and be arranged for use under the heavy modern electric motor cars. The drawing shows the use of spoke wheels. Recent practice has changed these to plate wheels,

From the latter point a duct extends laterally from each side of the center girder, delivering the air where it is needed. The motor leads pass through holes in the truck bolster close to the center plate so that the curving of the truck creates the least possible amount of distortion in the leads. Fortunately the necessity for making some such provision was foreseen a

number of years ago and it has not been necessary to make any important modifications in the design of the truck bolster.

THAWING OUT FROZEN CARS

The illustration shows the interior of the thawing-out house of the Chicago & Western Indiana at Chicago, used for thawing out the cars. The house is about 175 ft. long and 34 ft. wide, and contains two pits in which heating pipes are located. About 2,400 sq. ft. of heating surface is provided, which with a steam pressure of 50 lb. will, in about three hours, give a temperature of 110 deg. Fahr. during the coldest weather. For cars that are generally frozen up this house has proved invaluable, especially during the severe winter of 1911-1912.

Interior of Thawing House, Chicago & Western Indiana

ORDERING AND HANDLING LUMBER

At a meeting of the storekeepers, mechanical and operating officers of the Atchison, Topeka & Santa Fe, at Albuquerque, N. Mex., September 26, 27 and 28, a number of interesting papers were read on the general subject of storekeeping. The following is taken from a paper presented by T. O. Wood, purchasing agent of the Gulf, Colorado & Santa Fe, at Cleburne, Tex., on the subject of "Suggestions as to the Proper Manner of Ordering Lumber":

Don't order all lumber 16 ft. long. About seven-eighths of the orders on the mills call for 16-ft. lumber, and if the requirements are made in lengths of 12, 14, 16, 18 and 20 ft., they could be filled by the mills in less than half the time than if the entire order was for only 16-ft. lumber.

Don't order any length longer than 20 ft. if two shorter lengths will do, as all lengths over 20 ft. cost additional, the cost varying about $1 per thousand for every 2 ft. over 20 ft.

Don't order boards 12 in. wide if smaller widths will do, as the price increases above 8 in. in width. In ordering surface lumber for building, if possible order all lumber in rough sizes, or all in finished sizes, the latter much preferred. Some requisitions show both, and it is difficult for the person doing the purchasing to know what to obtain.

Don't forget to state in all cases where surface lumber is ordered, just what sides and edges are to be surfaced. Calling for it as dressed, finished or surfaced, without stating how this is required, is like calling for boards and giving no dimensions.

Where grades are not known by those ordering the lumber the purpose for which the lumber is to be used should be stated on the requisition, as this will give the purchasing department an opportunity to determine the grade desired. This point should be given careful consideration as it may save unnecessary expense to the company in the course of a year.

The following methods will prove satisfactory for storing lumber: All stacks should be from 2 ft. to 3 ft. above the ground to allow free circulation of air and they should be pitched one inch per lineal foot. Each piece should be exactly over the piece underneath it, and from 1 in. to 1½ in. apart from the pieces on each side for 4 in. lumber. This space should be increased up to 3 in. or 4 in. for lumber up to 12 in. wide. The cross pieces should be the same as the material to be stored when lumber and timber 1 in. to 4 in. thick is used. For 6 in. timber, and over, this plan would run the stack too high, and 1 in. or 2 in. strips of waste lumber can be used. These cross pieces should be placed on every layer, about 4 ft. apart, and the front pieces should project ⅛ to ¼ in. over the ends to protect the stack from the sun and rain. When the stack is completed one piece of the material used in the stack should be placed over the space between each tier. Some saw mills put an air space 12 in. wide in the center of the stack, which they call a flue. Others do not. Probably this is a matter which should be regulated according to the climate.

However one may vary from the above directions, the following rules should be ironclad: Be sure that the center bearings of each stack are not lower than the end bearings. The line should be straight to avoid sagging and the consequent accumulation of dampness. Be sure that the cross pieces are exactly over each other, else the lumber will become crooked, and be sure that decayed or rotten lumber is not used for cross pieces or foundations, as it will contaminate the good lumber.

The Making of Good Car Inspectors

It Is Evident that More Attention Must Be Given to the Selection and Training of These Men

Among the many papers submitted in the competition on the training and developing of car inspectors, that by A. M. Orr, Bessemer & Lake Erie, Greenville, Pa., was awarded the first place. Several others, however, were in the same class as Mr. Orr's although differing greatly in the method of treatment and the facts which are developed. These will be published in future issues. Mr. Orr's article and one other follow:

FIRST PRIZE ARTICLE

BY A. M. ORR
Bessemer & Lake Erie, Greenville, Pa.

First, what are the qualifications of a good car inspector? They would seem to be good health, good eyesight, experience in repairing cars, sufficient knowledge of English to make out reports, and knowledge of the M. C B. rules.

SELECTION

So far as the railroad is concerned, the most important moment of the life of the car inspector is when he is employed or transferred to a job which puts him in line for promotion to the position of inspector: and a majority of the troubles with car inspection forces could be avoided by an intelligent choosing of the men who are later to be promoted to be inspectors. It requires as good a man for the position of car inspector as is required for the position of foreman, with the exception that the inspector does not need as much ability to handle men. Yet the inspector is ordinarily advanced as a matter of regular routine, without any choice whatever being exercised in his selection.

There should be some definite point in repair yard work, where the line of promotion to car inspector separates from the ordinary line of repair work; and at that point a selection should be made from among the men who desire to qualify as inspectors. This selection should be made by means of physical and mental examinations, the mental examination being confined to an investigation to determine whether the man has a competent control of English for practical purposes and a working knowledge of the M. C. B. rules. No attention should be paid to errors of spelling or grammar unless they are of such a nature as to indicate that the man cannot understand clearly or make himself understood in English. This may appear to work a hardship where foreigners are used for repairmen, but if we expect harmonious action between the units of the transportation, the maintenance of way and the mechanical departments in a terminal yard, it will be necessary for all the responsible men to understand each other clearly, and that means of necessity a common language.

The physical examination should be intended to disclose organic defects rather than temporary ailments. It should include also a complete optical examination, especially for color blindness. It is not as necessary for inspectors to be correct in their optical judgment of colors as it is for a man in the transportation service, but in such a preliminary examination, where no hardship will be done by turning the man down, it is best to take the safe side. The results of the physical examination, as well as of the mental examination, should be retained for future comparisons.

Objection may be made that mental examinations at this time are useless, and that it is not of value to examine a man physically when he is not to be an inspector for years, if ever. There is a certain amount of truth in this, but if the men with organic troubles or with chronic disease, and the men whose knowledge of English is so slight that they cannot express themselves are eliminated in the beginning, then it will not be necessary to spend several years giving them special training.

TRAINING AND DEVELOPMENT

After having passed such an examination, the man should be given a training somewhat along the following lines:

4 months at truck work.
4 months at heavy steel car work.
4 months at heavy wood car work.
1 year in a light repair yard where foreign cars are repaired.
1 year oiling.

Following this, he should either be retained as an oiler or be used as a light repairman in the yard where he will most likely be an inspector when the time comes for promotion. It hardly seems necessary to attempt to go into detail as to the exact things the man should learn in each position. These will come to him step by step, with the aid of his associates and of his different foremen.

A more complete examination in English and on the M. C. B. rules should be given when the man is ready for promotion. There should be an improvement in the use of English in the years which have elapsed since the first examination. It will be noted that the phrase used is " the use of English"; it is essential to remember that a man may be able to convey his thoughts clearly, even though his language is not grammatically correct. He should have a fairly complete knowledge of the M. C. B. rules at this stage, particularly for inspectors who are likely to be assigned to interchange work.

Last comes the question of the development of the inspector after he is in service as a full-fledged inspector. It is probable that the average car inspector could be made at least 50 per cent more effective on interchange work by consistent instruction, either by the correspondence school methods or by personal instruction from a man sent from headquarters who is fully posted on the application of the M. C. B rules, as modified by the arbitration committee decisions. Whether the gain is worth while or not is a question. It is possible that the added efficiency will not be sufficient to justify the additional cost and trouble.

On the subject of safety inspection, however, there can be no question, and the highest possible efficiency must be obtained, whether in interchange or in terminal inspection. An effective method for developing the inspectors is simply to assume that their education was complete when they were placed under the inspector rating, and to make no definite attempt to give instruction after that time. This naturally involves a study of the record of the results obtained by each inspector, which tends in itself to develop the inspectors, as a knowledge that a superior has a permanent record of one's failures tends to sober down even the most reckless.

INDIVIDUAL EFFICIENCY

To establish this record defects should be divided into two classes, one to include cars which had defects that caused wrecks, or which made it necessary for cars to be set out en route. This is an arbitrary division; it may be modified in any way, but the principle involved is that there is no real difference between missing a defect which causes a wreck and missing the same defect when "luck" lets the car run safely to the next terminal, to be caught by an inspector there. As the division must be arbitrary, any division of very serious cases from ordinary cases may be made. As suggested above, let one class include perhaps all defects which have caused wrecks or derailments. Let the second class include all other cases where defects involving safety are

discovered and where the conditions seem to prove clearly that the defect was missed by an inspector.

Make it established practice to investigate officially every case of the first class and inflict discipline where it is found that an inspector is responsible, even if it be only a letter which is unknown except to the inspector and his foreman.

Pay no attention to the errors of the second class beyond ascertaining the name of the inspector who last passed the car and calling his attention to the defect in a routine way through his foreman. Use the record only when discussing discipline or promotion, with the exception that at intervals of a year or more an abstract should be made of all errors reported during the year. The record of any single error is as near being absolutely valueless as can be, but a general abstract will call attention at once to the man who has to inspect cars too close to a wall which shuts off the light from the under part of the cars, the man who is suffering from illness to an extent which makes him careless, the man whose eyes are going wrong, the man who is dissipating or who has family troubles which have "got on his nerves"; in general, every man who is not doing his best. Knowing which men are not doing their best, it is a simple matter to pay special attention to them and find whether the causes of their troubles can be removed or whether they need to be shifted to some other line of work. All this information will come automatically from the continual investigations and the records of the investigations.

If, at the end of the year or other period of time, we find that the average inspector has three errors charged to him, and some one inspector has 30 errors in the same time, we have an automatic warning that the work of that inspector needs attention. The trouble may be due to conditions beyond the control of the inspector, and even if under his control, there may be a reasonable excuse, but the fact that such cases come up and are investigated and that a useful record is made of them is probably the greatest thing which can be done toward developing the inspector into a conscientious workman.

PERIODICAL EXAMINATIONS

At intervals of perhaps three or five years examination sheets should be made up covering the M. C. B. rules as they apply to foreign cars, and also covering any special local regulations desired. This should be handled from the standpoint of the correspondence schools, whose motto is that a man learns a thing thoroughly when he lays it out in his mind and puts it down on paper. The examiner should pay no attention to the form of the English; anything should go which shows clearly that the man could handle the situation on interchange, and no restrictions should be put upon reference to the M. C. B. rules, the M. C. B. arbitration decisions, or other sources of information.

The following is a sample of an examination sheet for car inspectors:

Examination Sheet for Car Inspectors

What is the object of the M. C. B. rules?

When is a company, operating the cars of another company, responsible for the defects on such cars?

Who is the judge as to whether a car offered in interchange is "safe and serviceable"?

What is done with a defect card and its stubs after the card is made out?

What should be done if an inspector of a connecting road asks for a copy of a defect card?

When would you refuse to give a defect card for defects on a car?

Under what conditions would you receive a car having defects for which the owner was not responsible?

What are the defects of wheels for which an owner is responsible?

What is the defect of wheels for which they should be most closely inspected?

For what defects of the axles are the owners responsible?

How can you tell if a car is loaded too heavy for its axle capacity?

For what defects of the trucks are the owners responsible?

For what defects of the brakes are the owners responsible?

Why are the interior parts of the cylinder and triple exempted from the general rule that the delivering company is responsible for missing air brake material?

If a car is equipped with air-signal pipes, who would be responsible if the signal hose and angle cocks should be missing when the car was offered in interchange?

For what defects of the body are the owners responsible?

What does the rule regarding the standard height of couplers mean?

What are the requirements for grab irons and handholds?

If a company makes wrong repairs to a foreign car, to whom is it responsible?

What is the meaning of the phrase "unfair usage"?

What defects of a car should be repaired?

What do you consider the most important principles covered by the M. C. B. rules, so far as the repairing of foreign cars is concerned?

If you could not obtain the proper material for making repairs to a foreign car promptly, what would you do?

Are you allowed to use second-hand material in repairing foreign cars?

When must you show on your stub that material applied was second-hand?

When a foreign car is found with the coupler above or below the limits of standard height, what should be done?

May draft timbers be spliced?

Give a rough sketch of the proper method of splicing sills, and give your idea of the rules governing the splicing of sills.

What do the M. C. B. rules say as to the application of air hose?

What are the rules regarding the giving of joint evidence cards?

What special information must be shown on repair cards, as, for example, in the case of brasses and similar material?

If you make only a part of the repairs on a car which are covered by a foreign defect card, what should you do with the card?

In what case is it necessary to show on your repair card whether the car had a stem or pocket coupler?

How do you check your car numbers and initials so as to avoid as much correspondence as possible over correction of stubs?

If a car was offered to you in interchange with a part missing from its place, and a defect card on the car for the part "loaded in the car," what would you do?

How could you tell if a carload of long material was not too large to pass through to its destination without being transferred on account of being too large to go through a tunnel?

If you were sent out to inspect a load of telegraph poles, loaded on two cars, what things do you consider it necessary for you to specially inspect about the cars and their lading?

What are the requirements for blocking, etc., on a flat car loaded with large stone?

How many brakes must be effective on three cars chained together and loaded with long steel?

What are the requirements for side stakes on loads of telegraph poles?

Describe the testing of the air brakes on a train.

What are the general duties of an inspector as regards the air brake apparatus?

What are the air brake defects for which you should be most particular to inspect?

What is the requirement as to piston travel?

If you found an air brake defect which could not be repaired at your station; or if for any other reason it was desired to "cut out" the brake, describe fully what you would do.

Why is it necessary to test the air on a train when it is first made up, and thereafter whenever it has had its cars changed around?

Beyond this, it does not seem necessary or profitable to go. It would be much nicer to have a nice lot of inspectors, all intelligent users of English, all in perfect health and with good judgment, but heaven has not yet come to the railroads, despite the earnest endeavors of the interstate and the various state commissions, and it is necessary that we be satisfied with a good average.

MAKING A CAR INSPECTOR

BY E. C.

In order intelligently to discuss how car inspectors should be trained and developed and what are their qualifications, it would be well to consider their duties and the conditions under which they work.

The object to be attained in the inspection of cars is primarily the discovering of defects that are liable to cause disablement of the cars during transit, with resultant delay to traffic, wrecks and possible loss of life; the same applies to the lading in the cars, particularly in open cars.

In making his inspection of a car, the car inspector must be alert to discover, first, the parts that have actually broken down; second, the defects which may develop into subsequent failures, and third, those defects which, while of a minor nature, must be considered and judgment exercised in deciding whether they

should be remedied at the time or the car be permitted to proceed.

THREE CLASSES OF INSPECTORS

There are three phases of inspecting: initial, interchange and intermediate. The initial inspector, who inspects cars before and after loading, has probably the most varied duties of any; he bears the responsibility of deciding whether or not cars are in fit condition for carrying a variety of commodities; he must inspect box cars inside as well as outside.

Some cars are fit for certain shipments and unfit for others; some he may take a chance on if the weather appears to be settled, but not otherwise. Some cars he does take long chances on and is commended as being a "good" inspector by the agent or yard master, who at the time are hard pressed to supply the shippers with cars. The initial car inspector must know that the loading is done in conformance with the rules; he must also know that the dimensions of cars and lading are within the clearance limits for the routes over which they are to travel, and must never forget the safety appliance law. In short, this man bears the responsibility of seeing that cars and lading are both in the proper condition to reach their destination in safety. Should he fail in the discharge of his duties he may cause his employer unlimited expense by reason of transfer, delays in transit, claims for damaged lading, additional cost for repairs and possibly thousands of dollars on account of a single wreck.

After the initial car inspector comes the inspector at points of interchange. His duties are similar as to hunting for defects in running gear, sub- and superstructure, testing of handholds, steps and ladders; examining running boards, box car doors and the seals, and also the loads to see that they have not shifted. He must also think about dimensions of cars and lading and not let any slip by that exceed the limit of routing. While all car inspectors must be familiar with the M. C. B. Rules, the interchange man has to apply them more frequently than the others. The intermediate man or the inspector who is stationed between the point of loading or interchange and destination has all the duties of the latter, with the exception of applying the rules of interchange, but he must be familiar with the M. C. B. Rules that apply to any repairs that he may make.

GENERAL REQUIREMENTS

In addition to the inspection mentioned, all inspectors are required to keep accurate record of defects found, repairs made, and cars marked for the repair tracks. Some of these records must be so-called "original" records, *i.e.*, the first record made, which must be filed for future reference. M. C. B. billing repair cards have to be made out by the car inspectors for repairs made by them.

So much in a very general way for the duties of the car inspector, now let us consider the conditions under which he must perform those duties. No matter what the weather—rain, blizzar, bitter cold or sunshine—he must be on the job, over the tops of cars, along by the sides and frequently underneath, intently looking for the least as well as major defects. In yards and at transfer and freight stations the tracks and platforms are usually so close to one another and the cars that the light during daytime, particularly on cloudy days, is not sufficient to reveal such defects as seams in throats of flanges, cracked arch bars and similar defects. A lantern, unless it is very dark, is of little assistance; rain also hides some defects, and it need hardly be said that snow and ice cover up many others. Nevertheless, the car inspector must not be guilty of failing to detect any defects that reveal themselves by some disaster later on.

RELATION TO OPERATING DEPARTMENT

Then, in classification yards in particular, there is the yard force, headed by the yard master, who never by any chance makes the car inspectors' work easier, but rather the reverse! The time allowed in which to inspect a train, whether the latter consists of 20 or 100 cars, is usually 30 minutes, which by cajolery or otherwise, depending upon the man, the yard master, or one of his numerous assistants, frequently tries to have shortened to enable the quicker movement of the train through the yard.

The car inspector is at the "beck and call" of everyone and is the most cussed man on a railroad. Should a trainman discover some little defect when making up a train he wants to know where "that ——— car inspector is," or if the latter puts the former to the trouble of cutting out a car from a train that is made up, the same gentleman invites the poor car inspector to go to a very warm place.

It probably is a fact that our friends, the yard people, would rejoice if every car inspector were discharged offhand, for their immediate troubles, for which they hold the car inspectors responsible, so overpower their reason that they fail to appreciate the immeasurably greater trouble that is saved them every day by the work done by these much-abused men.

TRAINING AND DEVELOPING INSPECTORS

I think it is not exaggeration to say that car inspectors as a class and by their unassisted actions prevent more accidents on the railroads of the country to-day than any other single class of railroad employees.

What manner of man, then, must the car inspector be, and how should he be trained and developed? As it is not ordinarily practicable to select the future car inspector from applicants for "jobs," no more than the usual care can be exercised when employing men. Depending on circumstances, car inspectors are usually developed from car repairmen. Without question, they should always be car repairmen on regular repair tracks before promotion to inspectors. By working on repairs the men become familiar with the various parts of cars, how to make repairs, the character of defects found by the inspectors, and this is done directly under the eye of the foreman, who thus has opportunity to become thoroughly familiar with the varied characteristics of his men.

At this stage in the development of a man a great deal depends on the foreman. If he is not what he should be, good car inspectors will not be developed under his tutelage, but as this article is not on the qualification of the foreman, that phase of the subject will not be discussed, and we will assume that the foreman is the right kind of man. After a few months on the repair track—in speaking of the repair track I do not mean at the main shop, but the tracks set apart for heavy running repairs, light running repairs being made in the receiving or classification yards—during which time our man should be given every kind of repairs to make, he may then be sent out into the yard to oil and sponge journal boxes or make the minor repairs which will prevent cars from being cut out for the repair track.

Only those who have exhibited an interest in the work of the repair track, and on whom dependence can be placed, should be selected for this work. The man who has been lazy, unobservant and indifferent should never be sent out, for he will now be away from under the eye of the foreman and will be placed more or less on his honor for the faithful and diligent performance of his duties.

After filling the places of oilers or repairmen, who are off sick or otherwise absent, the prospective inspector will be given a regular place, probably at night; first, as oiler, if possible, or as repairman, from which he will work in his turn to a similar day position. In possibly two, three or four years the opportunity comes for his advancement to the position of inspector. Prior to that time, however, he will have filled temporary vacancies as inspector, and in this way have obtained actual experience, although his opportunities while repairman in the yard were ample to develop his faculties of observation.

As inspector, his first duties should be overhead inspection, since the more important end is that of running gear, couplers and parts near the ground; in course of time, and as opportunity affords, he should be promoted to the ground. I use the word promoted advisedly, as I believe that the ground man should

receive a higher rate of pay than the roof, or overhead, man, since the former position requires more concentration of thought, a keener eye, more frequent exercise of judgment and a greater variety of parts to be inspected, and in every way demands higher qualifications on the part of the inspector.

For inspectors who are required to supervise loading of cars, in particular of explosives, structural iron and other long material, only those who exhibit good judgment, coupled with a fair knowledge of the various rules and regulations, or are known to be capable of acquiring and applying that knowledge readily, should be selected. Likewise only the best-equipped men should be used where interchange work is involved.

The training of men does not cease when they become inspectors, as the least of them will slack off more or less unless the foreman follows them up in their work, not in a nagging, but rather in an educational way, encouraging them to overcome the difficulties that beset their path and perfect themselves in their duties, imparting all the knowledge of which he himself is possessed and guiding their judgment in the right direction.

It would seem that the prevailing idea in circles other than that of the car department is that a car inspector can be made overnight out of any old kind of material; such is far from being the case. Very few of the men offering themselves for this work or remaining in the occupation are naturally good inspectors; such men do not find the rate of wages sufficiently attractive. It takes years of persistent, concentrated effort to make a proficient car inspector and continued years of similar effort to keep him up to the mark.

The opportunities for advancement open to a car inspector may truly be said to be unlimited, for they depend upon the man himself, as in all other occupations. Of course, within the immediate horizon of the somewhat better than average man it must be regretfully admitted that the opportunities are not numerous. First there is gang leadership at a small advance in wages, and then the position of foreman, at which he is apt to stop unless possessed of qualifications not ordinarily found among car inspectors.

CONCLUSION

In conclusion, a car inspector should be:

(1) Faithful in his duties, even under the most adverse circumstances, loyal to his employer.

(2) He should be alert, keen of eye and observant, possessed of good judgment and a desire to improve.

(3) He should have a thorough knowledge of the various rules pertaining to his work and be capable of applying them intelligently.

(4) Last and not least, he should be possessed of an equitable temperament.

The question of development and training of the car inspector may be summed up in a very few words. Given the right kind of man, the rest depends almost entirely on the foreman and the way in which he handles the man.

The average man in all walks of life requires a lot of encouragement to keep him up to his best efforts, and the car inspector perhaps requires a lot more than the average and needs more judicious sympathy than usually comes his way.

Chemically Removing Rust.—The chemical removal of rust from iron was treated in a paper recently presented to the Iron and Steel Institute in London. Dilute solutions of sodium citrate have been usually recommended as suitable media for loosening rust without dissolving any iron, but the authors of this paper point out that these solutions are unsuitable for investigations involving the quantitative removal of rust and that they are also extremely slow in their action. Various other chemical reagents were tried, none of which proved as useful as boric acid. It did not appear possible to find a reagent which would remove rust quantitatively without also dissolving some of the iron.

CHILLED IRON WHEELS

The Association of Manufacturers of Chilled Iron Wheels met in New York on October 12. All of the officers were re-elected. They are as follows: President and treasurer, George W. Lyndon; vice-presidents, E. F. Carry and J. A. Kilpatrick; secretary, George F. Griffin; consulting engineer, F. K. Vial. The board of directors consists of E. F. Carry, J. A. Kilpatrick, W. S. Atwood, Charles A. Lindstrom, F. K. Vial, A. G. Wellington, W. C. Arthurs, J. D. Rhodes, F. B. Cooley, A. J. Miller and William F. Cutler. In addressing the meeting President George W. Lyndon said, in part:

It is gratifying to know that the chilled iron wheel has not only been able to maintain itself as the wheel standard of the United States and Canada, but it is beginning to supplant the European standards, as evidenced by the fact that several manufacturers of this association are supplying chilled iron wheels in large quantities to the French and Russian governments.

That our flange recommendations are in the line of improvement is fully demonstrated by the fact that we have at the present time over one-half million wheels running that are finding their way through the present track construction without any complaints. The flange used on special wheels is 3/32 in. thicker than the M. C. B. flange, and the flange as shown in our final argument is 3/16 in. thicker at the gaging point than the M. C. B. flange.

It is our purpose to have a sufficient amount of metal in reserve in order to enable us to design a chilled iron wheel of 950 lb., or heavier; in other words, we are building for the future. We do not want the limits of the possibilities of the chilled iron wheel confined by the limitations of flange design. We want no unreasonable restrictions in the use of the chilled iron wheel.

In March of this year we submitted to the chairman of the wheel committee of the M. C. B. Association a new set of standard specifications, recommending the following:

650 lb. wheel—brake pressure	19,000 lb.
750 lb. wheel—brake pressure	32,200 lb.
850 lb. wheel—brake pressure	40,000 lb.

and detailed drawings of M. C. B. types of wheels and arch plate type of wheels.

There is absolutely no limit of weight in the case of steel wheels, but when it comes to a design of chilled iron wheels, all sorts of restrictions follow. We all know what an additional 25 lb. of iron will do to any of the standard M. C. B. wheels in the matter of drop and thermal test, and the proof of this is manifest in our 625-lb. M. C. B. pattern, which we were enabled to redesign in the year of 1909 by the additional allowance of only 10 lb. of metal.

There are some tests which would establish the chilled iron wheel on a much firmer basis, and I believe would be advantageous to all manufacturers. The tests that I refer to are comparative tests of the chilled iron wheel and the steel wheel.

1—Relative wearing values when rotating on a steel rail under various loads, the tread wear and flange wear to be observed separately.

2—Abrasion of rail under various conditions of loading.

3—Determination of the intensity of heating stresses in all parts of the chilled iron wheel, namely, single plate, intersection of plates, front plate, back plate, brackets, etc.

4—Analysis of the thermal test. Intensity of stresses in various parts of the wheel, and effect of thickening the thermal ring, increasing and decreasing the temperature of the iron, etc. The thermal test should be made an intelligent one instead of the present crude affair that is supposedly alike for all weights of wheels.

5—Determination of stresses in the hub and plates of the chilled iron wheel due to pressing on axles. Variation in stresses due to various classes of machining.

SHOP PRACTICE

DRILL MOTOR EXTENSIONS

BY V. T. KROPIDLOWSKI

A convenient set of telescoping extensions is shown herewith, which has been developed for use with air motors in all drilling operations about a locomotive. These tools are in constant demand by the floor hands, and are rapidly replacing the "old man,"

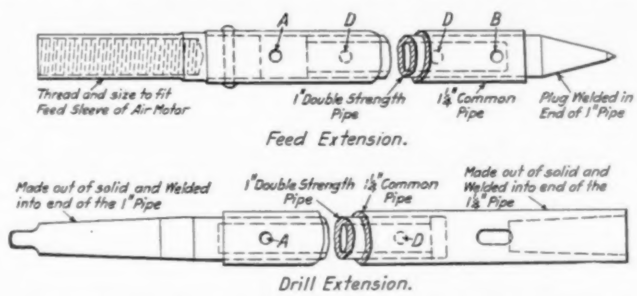


Fig. 1—Construction of the Motor Feed and Drill Extensions

the reason for their preference being their lightness and ease of application and adjustment.

Fig. 1 shows the construction of the extensions for both the feed end and the drill end of the motor. As is seen, the tools are made out of 1¼-in. single-strength pipe and 1-in. double-strength pipe. The feed extension has a plug welded into the

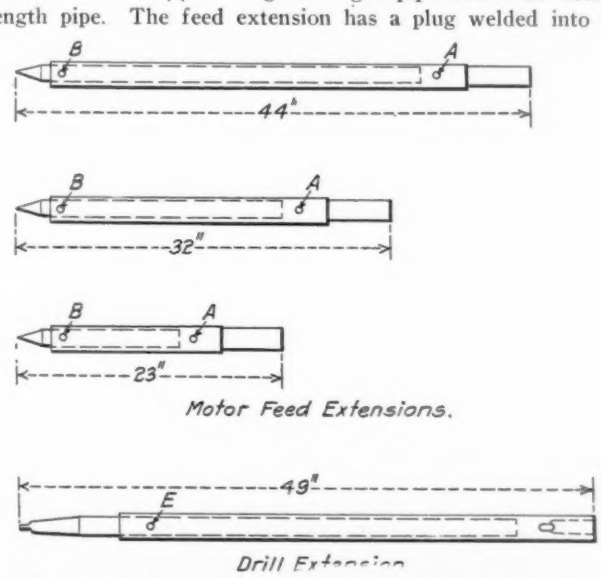


Fig. 2—Sizes Used for a Set of Drill Motor Extensions

end of the 1-in. pipe, which is pointed and serves as a center. In one end of the 1¼-in. pipe is riveted a machined piece which is bored out and threaded on the inside and turned on the outside to fit the feed sleeve of the air motor. The drill extension has a Morse taper shank welded into the end of the 10-in. pipe, and Morse taper socket in one end of the 1¼ in. pipe. Through the inner, or 1-in. pipes of both extensions are drilled holes *D*. These are spaced 2 in. apart and are 7/16 in. in diameter. By means of them the tool can be extended or shortened, being held in the desired position by the insertion of a ⅜-in. pin through a hole in the outside pipe and one of the holes in the inside pipe. The holes in the outside pipes of the feed and drill extensions are shown at *A* and *B* respectively.

A set of three of each of these tools, or six in all, fills all the requirements of drilling operations about a locomotive. The lengths to be used are shown in Fig. 2, but one length being shown for the drill end. The other two should be made of such lengths that they will have the same ratio to the full-length extension shown as the shorter motor feed extensions have to their full length tool.

Fig. 3 shows the method of using the extension tool for the feed end of the motor in drilling a running-board bracket. All

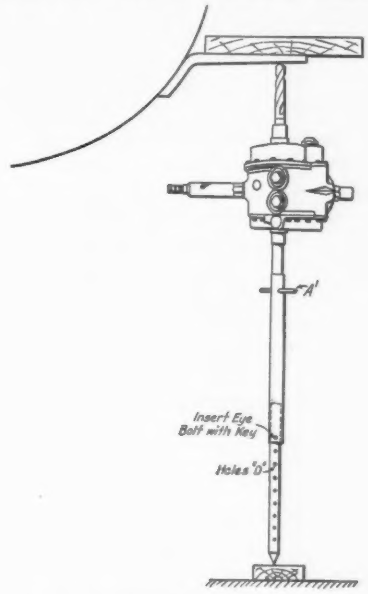


Fig. 3—Method of Using the Feed Extension

that is necessary is to remove the star feed from the motor and screw on the extension, pull out the inner pipe until it has the required length to suit the distance from floor to running-board, then insert the pin or eye bolt to keep the tool in the extended

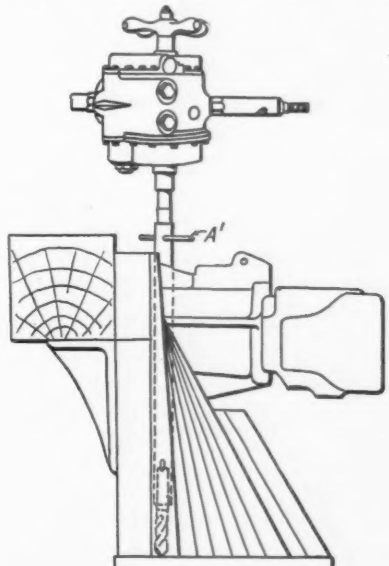


Fig. 4—Using the Drill Extension in Drilling a Pilot Heel Plate

position. The motor is then set up and final adjustment made with the feed by turning on the pin A^1.

Fig. 4 shows one example of the use of the drill extension in the operation of drilling the heel of a pilot, which is self explanatory.

This set of tools greatly facilitates the work of many drilling

operations. Among these may be mentioned: Drilling across the frames; all inside fire box drilling; bumper beam plates; drilling running boards in place; stay bolts in throat sheets and holes in heels of pilots for pilot braces.

PROTECTION OF IRON AND STEEL

BY J. W. GIBBONS
General Foreman Locomotive Painters, Atchison, Topeka & Santa Fe, Topeka, Kan.

We must have some knowledge of the composition of a material and of the agencies that commonly enter into its destruction in order properly to protect it. Thorpe, in his Dictionary of Applied Chemistry, quotes a number of authorities to prove that the corrosion of iron and steel is caused by an electrolytic action which takes place between the metal and its impurities when moisture is present. The impurities are carbon, manganese, etc. These constitute an electro negative, the metal an electro positive and the moisture the electrolyte which starts the electrolytical action, precipitating the metal into a solution. Air entering through the water causes a reaction which returns the metal to its original state, oxide of iron, commonly called rust. Acids augment and aid this electrolytical action and when they are present in the water accelerate the destruction of the metal.

Thorpe also states that some acids will neutralize the effect of others and that a combination of certain acids will stop all corrosion. It is also proved that in the absence of moisture, or in other words, the electrolyte, there can be no electrolytical action, hence no corrosion. Therefore in selecting pigments to make a paint, we should select "inhibitive" pigments which neutralize the acids. Carbon, being a stimulative pigment (electro negative), should never be applied next to metal.

It is generally accepted as a fact that a paint composed of a combination of several pigments gives better protection than a single pigment paint, providing, of course, that the pigments so combined are of different degree of fineness, thus complying with what Perry calls the "law of minimum voids." I believe that the several pigments also have the same tendency that a mixture of certain acids has, as explained by Thorpe, namely, to neutralize the electrolytical action.

As all authorities agree that in the absence of moisture there can be no electrolytic action, or corrosion, in selecting a vehicle for the pigments it is essential that an oil be used which when mixed with the pigments will be the most impervious to water.

When we consider that uric acid and ammonia are deposited on stock carrying equipment, and sulphuric acids on coal carrying vehicles, and that sulphur fumes from coal-burning locomotives are present on all railway equipment, it is apparent that an oil which will absorb a high percentage of moisture will carry these destructive acids into the paint next to the metal and accelerate its destruction.

To determine what would make the most impermeable vehicle,* I made the following tests:

Exhibit A was composed of films of treated and non-treated linseed and other oils. Each film was submerged in water for 72 hours and the films have been marked, showing the percentage of increase in weight, or in other words the amount of water absorbed. This test also brings out the fact that the accelerated method of testing the elasticity of paint films employed by paint chemists is of no value unless a test of contraction is also made. To illustrate this films 7, 13 and 14, which will stretch more than their own length without breaking, are as brittle as glass at 8 deg. F., and have no value as a paint vehicle when exposed to a low temperature.

Those films marked with the letter "B" were baked at 135 deg. F., which, of course, properly speaking, is not baking, but accelerated drying.

The films numbered from 0 to 3 were made from the same grade of red lead, ground in the same mill and baked at 250 deg. F. The one marked 0 was mixed with raw linseed oil and increased four per cent in weight. Nos. 1, 2 and 3 were all heat treated oils, heated to different degrees of temperature. No. 3 was the only one held at a high degree of heat long enough to make a heavy viscous oil; it required a small percentage of volatile oil to thin it to a working consistency, but the film is as thick as any of the others made from the same number of coats, in fact, the raw linseed oil film is thinner and more fragile than any other in the same group. This demonstrates that in addition to giving protection against the absorbtion of water, the heat treated oils, if not thinned out excessively, will also give more protection against attrition than the raw or "bung"† boiled linseed oil paints. As the air dried films absorbed more moisture

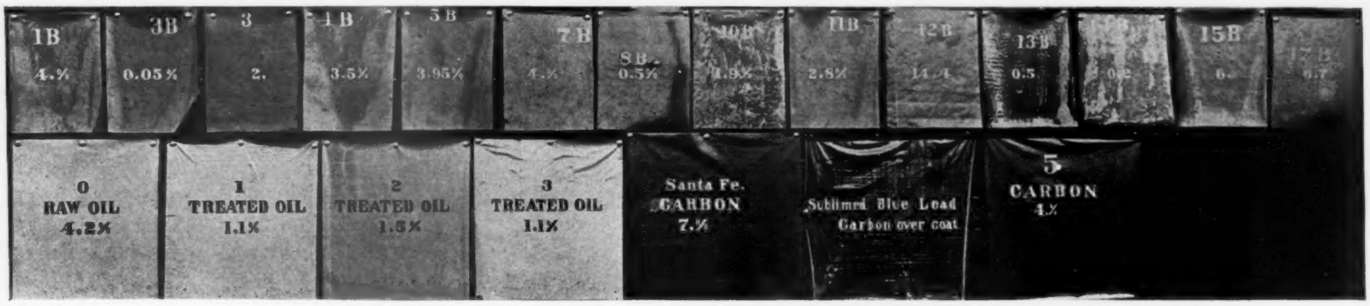


Exhibit A—Exposure Test of Films of Treated and Non-Treated Linseed and Other Oils

Exhibit B—Exposure Test of Sandblasted Steel Plates Which Were Given Two Coats of Paint and Bolted to Underframe of Locomotive Tender. Nos. 7 to 12 Inclusive Were so Placed that Water from the Tank Dripped on Them

* See test committee's report, Master Car and Locomotive Painters' Association, 1915. This report was abstracted in *The Railway Age Gazette, Mechanical Edition*, October, 1915, page 538.

† By "bung" boiled linseed oil we mean oil to which driers have been added; it is then sold as boiled linseed oil, although as a matter of fact the oil was never boiled.

than the baked films and the films baked at 250 deg. less than those dried at 135 deg., it is evident that the accelerated drying of paints by artificial heat is desirable. Practical tests exposed at five different points on the Santa Fe Lines in 1913 and 1914 substantiate this conclusion.

Exhibit B was composed of steel plates which were sand-blasted and given two coats of paint, a different mixture being applied on each plate. The plates were bolted on the interior of a steel underframe of a coal-carrying locomotive tender. Nos. 1 to 6 were in a position where comparatively little moisture came in contact with them. Nos. 7 to 12 were under a cistern which leaked; they became thoroughly saturated with water and deposits washed from the coal.

Exhibit C—Plates Which Were Treated the Same as Those in Exhibit B, and Were then Fastened to Roof of Passenger Coach

Exhibit C has the same paints as Exhibit B, but the plates were fastened on the roof of a passenger car, which was used every day for 10 months behind a coal-burning locomotive. The effects of the cinders, snow, rain, ice, etc., are apparent as the results of the test of Exhibit B and Exhibit C are comparatively the same; the only paints which have protected the steel to any considerable extent are those mixed with a heat-treated oil.

The service tests confirm the conclusions drawn from the film tests and prove the value of the film method of testing paints. Note the conditions of plate 7, which is recorded as a total failure. This is a single pigment paint (red lead) mixed by hand with raw linseed oil. The film made with the same grade of red lead and mixed by hand with "bung" boiled linseed oil absorbed 1/5 per cent more moisture than the same material ground in a modern paint mill. It proves the theory that a paint properly ground will give better service and will be more impervious to water than the hand mixed paints.

As red lead is worth at present 6½ cents per pound, and raw linseed oil 48 cents per gallon, and as 25 pounds of red lead mixed with one gallon linseed oil will make approximately 1⅓ gallons of paint, this mixture will cost $1.57½ per gallon, not counting the labor necessary to mix it. As the particles of pigment are comparatively large and coarse when mixed by hand, they contain a number of "voids" which increase the porosity of the paint film and expose it to the action of the destructive acids which may be present in the water.

Steel plate 11 primed with a combination of red lead silica silicates (Asbestine) and calcium carbonate ground in heat-treated oil, and second coated with a combination of carbon and basic carbonate of lead, ground in heat-treated oil, has given remarkable service under very severe conditions in three different tests, thus proving that it has elements of great value as a paint. I attribute its preservative qualities to two things, the impermeability of the oil obtained by the heat treatment, and the "minimum voids" in the mixture obtained by the different degrees of fineness of the pigments used.

In connection with this it is not out of place to mention that the Atlantic City fence test, conducted by the American Society for Testing Materials, proved to its satisfaction that sublimed blue lead was the best practical paint pigment for the protection of steel and as this pigment is exceedingly fine and will enter into the pores of the oil, I have no hesitancy in recommending as a primer for iron and steel a combination paint with a red lead or sublimed blue lead base ground in an oil which has been heat-treated.

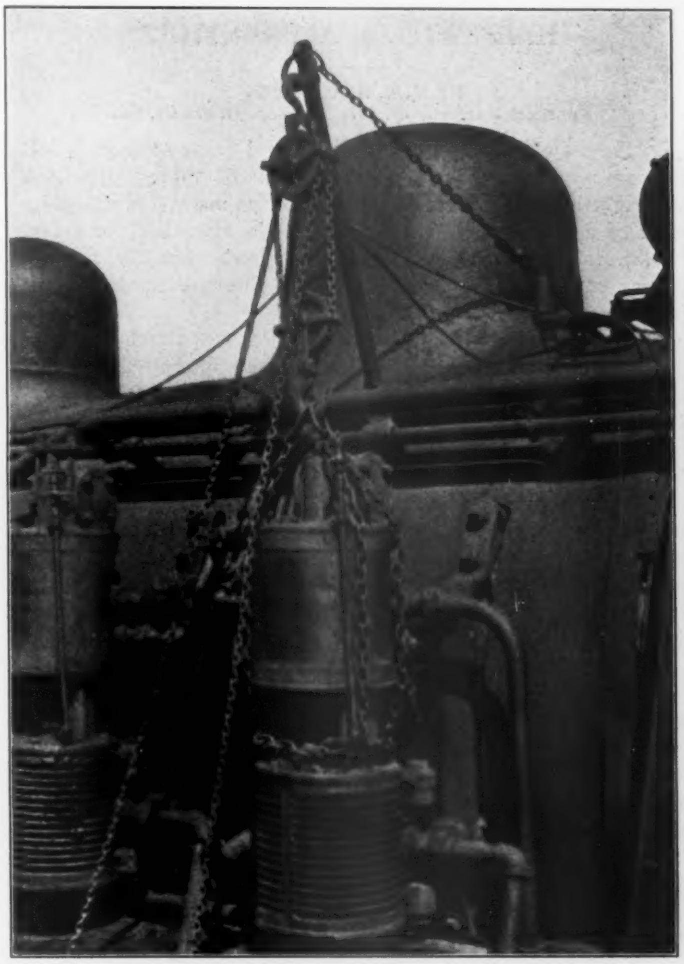
As carbons are inert and not subject to change by the action of acids or alkali, a combination paint with a carbon base, ground in heat-treated linseed oil, will make a good over or finishing coat. Where three coats are necessary or desired, the primer and finishing coats should be mixed together in equal parts and used as a second coat. These paints can be purchased for less than the single pigment red lead paints can be made by hand.

As the value of a protective paint may be destroyed by excessive use of thinners or by improper application, and as the average journeyman painter knows or cares but little about the composition of the material he is employed to apply, it becomes absolutely necessary, in order to secure good results, to have intelligent and efficient supervision.

DEVICE FOR PLACING AIR PUMPS

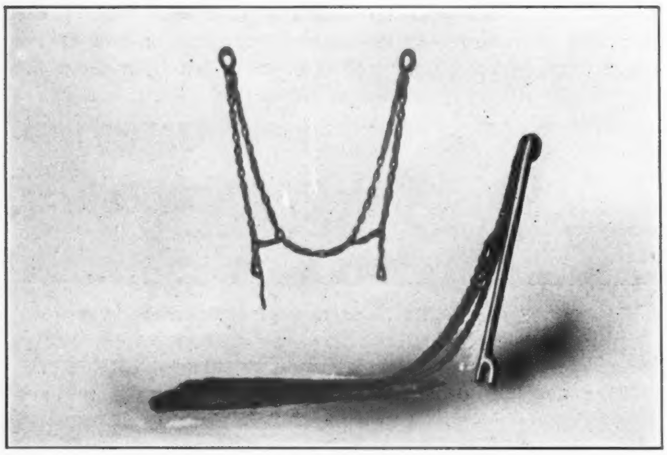
BY W. S. WHITFORD
General Foreman, Chicago & North Western, Milwaukee, Wisc.

The device shown in the accompany illustrations is in use at the Chicago & North Western shops at Milwaukee for hoisting air pumps into place on the locomotives. The device consists of a pole to which are attached two long chains, and a special



Air Pump Being Placed in Position on the Locomotive

chain sling which is attached to the air pump. The pole is made of 2-in. pipe, the lower end being forged and welded to fit over the hand-rail and the upper end provided with a means for attaching the chains and a link to receive the hook of the upper chain block. The chains are long enough to be extended over the boiler and are attached to the hand rail on the other



Details of Chain Sling and Pole with Supporting Chains

side of the engine thus securing the pole in the desired position over the air pump bracket. The air pump sling is shown in one of the illustrations and consists of a belt which is fastened around the central part of the pump and to which are secured the lower ends of two double lifting chains. The upper ends of these chains terminate in links which hook into the lower chain block.

HELPING THE APPRENTICE*

BY H. E. BLACKBURN
Apprentice Instructor, Erie Railroad, Dunmore, Pa.

In the majority of shops the hiring and firing of boys is left to some foreman who has no interest in the apprentice school, and right here is where the first mistake is made, for the judgment of a Solomon is needed to select the right boy for a certain trade and unless some one person who has the school's interest at heart is held accountable for results the value of the instructor is lost.

If the instructor wishes to win out with boys worth while, he will have to find some way of keeping them interested in a line of practical work in connection with the shop problem work. To do this he will have to have a strong personality so as to resort to tact, for mother wit and common sense is the only "dad" to whip boys into line for mechanics.

A boy may like you personally, but he may hate your methods of discipline—it is fatal to force a boy to do a thing against his own limitations. It is far better to try him out on something more to his liking until you can get him to see things in the proper light. To do this you will have to overlook his many shortcomings and become his only aid when he is up against a hard proposition. The primary aim of the instructor should be to teach the boy by actual example because the eye is the greatest educator, and objects and not books are the prime factors for a lasting impression as to how the work should be done. Books and theories have their place, but not with a first year apprentice, for the average boy who "sees" the wheels go around will immediately want to know why they turn, and what makes them go; that is, if he is the right kind of a boy to learn the trade.

Instead of giving all the boys a general lecture, which is liable to lead to "heave ho" methods, have a heart to heart talk with each boy relating to the work he is doing in the shop; give him some problems that specially cover his work, but do not tell him all that you know about the subject. It is better to make him work out his own salvation from the study of models and charts.

Another fatal mistake is that the average instructor does not know what is going on in the shop between the foreman, mechanics and the boy, for while the instructor is trying to show the boy some up-to-date method of working, the shop force may be coaching him to do the work twenty years behind the times; this keeps the school and shop efficiency down, simply because the boy does not know where he is at. If the boy is to become proficient he must know why he does the work a certain way, so as to use as few tools and movements as possible.

If the boy spoils a piece of work after you have been careful to show him how it should be done, don't "flare up," but find him more material and keep him at it until he makes good; then compliment him on the results and move him on to some better work. If he continues to improve make him a teacher, to show the next boy in line for the work how it should be done. It will please the boy and help the instructor, to say nothing of making him one of the "props" of the school. He will soon learn to pull for himself and try to pass the boy ahead of him. And if you can teach him that skill is only a matter of intelligent labor, and that higher mathematics are not needed to work out his daily problems, you will soon have a boy for the trade worth while, for first hand knowledge is the lasting knowledge that counts.

Avoid going over the same subject again, but compare any new subject to the past studies, if possible. As every boy has a natural dislike for some part of the trade, it is well to encourage them to become proficient in that part that they like best, so that their ability as mechanics may be recognized long before they are out of their time.

In order to help the apprentice so that he can help himself, build a small shop and equip it with machines, benches and tools (not junk), or set apart some machines and benches for the boy's use in the shop, so that he can work on regular shop output work. Next give him a living wage, so that he can support himself, and you will get more man and less "kid" for the money expended. As soon as he can do a good job on a day work scale, let him have all that he can make at piecework. Don't merely give him a certain per cent of it, if he does the work correctly.

Place the larger boys in the erecting shop, and the smaller boys on machines until they are able to cope with the heavy work. While in the shop, if the boy likes to draw, give him a set of drawing instruments and let him handle the shop drawing. Later on let him try to design some tool to help the shop output along. Advance the boy who does not like to draw as fast as he understands how to clamp and chuck work on the machines. Be sure that he understands how to grind cutting tools and how to use the proper feeds and speeds to get results. Make him watch you file and chip, not some "hunkie" who is "choking the hammer to death."

If you find a boy who thinks he knows it all let him build a model locomotive; it may change his mind. If you have a boy who does not realize his capability draw him out by having him help the boy who knows it all, and then remove the boy who talks and does nothing. It will shame one and encourage the other. It is good practice to let one boy criticize the other boy's work at any time.

While he is in school teach him the names of the various tools and their uses in the shop; in fact keep a model tool room in the school. Next start him out on lettering and straight line drawing. Also explain the three views of an object that are required in a drawing. Then let him make a free hand sketch. If he does not like to draw, do not waste any more time or

*Entered in the prize competition on "How Should Car Inspectors Be Trained and Developed, and What are Their Qualifications?" which closed October 1.

paper trying to teach him after he can make and read a fair looking print.

It is good practice to have the boys debate on subjects such as the standard ways of doing work. If the boy is encouraged to read railroad magazines and talk in school he will (if you have the right kind of a boy) see new things in the journals that will start him to figuring. Keep the school open at night. Organize a band or an orchestra. A wireless club will be the means of bringing in boys who like to fool with wire and batteries, and so you may find good material for an electrician; in fact, do anything to keep the boy off the street, for one season on the street has ruined more boys' chances than any other cause. Later on you will have an organization whose team work in baseball and football will give the school a good advertisement wherever they go.

As regards the future, much depends on the railroads and the class of instructors they employ to educate the apprentices. Germany has proved beyond doubt that it pays to educate and develop the mechanical genius that is going to waste in America.

PISTON VALVE PACKING RINGS*

(PRIZE ARTICLE)

BY W. F. LAUER
General Foreman, Illinois Central, Memphis, Tenn.

A successful steam locomotive depends largely on a perfect valve. It matters not how good a locomotive may be otherwise, if an inferior valve is used, or if the valve is not properly taken care of, the locomotive is a poor revenue earner. There are three vital points to be considered, and each is essential to the efficiency of the locomotive; these three points are: Kind of valve; its construction, and its maintenance.

The best valve is the piston valve, as it is the most equally balanced. The best constructed valve, considering the work that is done on it in the shop and the roundhouse as well as its service, is what is known as the "built-up valve." This consists

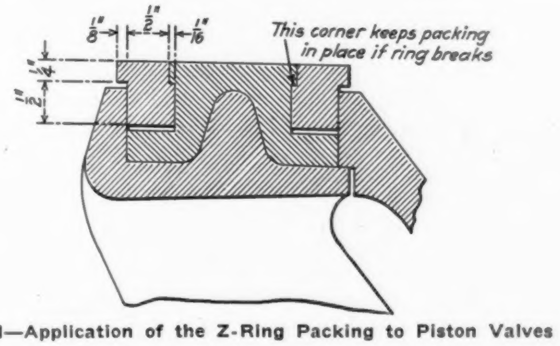


Fig. 1—Application of the Z-Ring Packing to Piston Valves

of two spiders made of cast steel, one spool or body made of grey iron, two bull rings and four packing rings. The bull rings should be of good material, sufficiently hard to avoid excessive wear. The packing rings should be of a high grade cast iron, that will retain its life or spring under the use of superheated steam. (There is an iron on the market today that fulfills this requirement.) The ring should be of the Z-shape type. This type is better than the rectangular, L or T-shaped rings, for the reason that it is so constructed that in case of breakage the parts of the ring will not work out of the groove (see Fig. 1), thus eliminating the possibility of the broken parts of the ring knocking out a cylinder head or breaking the valve bushing and causing an engine failure. When this type of ring breaks, the only result will be a "blow" in the valve, and the engine will be able to take the train to its destination with the broken parts of the ring in place.

The Z-ring should be machined on a boring mill, from tub castings large enough to produce 10 to 20 rings each. Both heads of the boring mill should be used, one for turning and the other for boring, both operations being done at the same time. The casting should be finished on the inside and on the outside before the forming or cutting-off takes place. Our method of cutting off these rings is shown in Fig. 2. The tool in the right head cuts into the inside of the tub the same as though an L-shaped ring were being made. The tool in the left head cuts off the ring from the outside and is so placed that it runs a trifle off the line of the inside tool, thus separating the ring from the tub and forming the "Z" section at the same time. No broken edges are caused by the tools going through and tearing the iron; all the corners are absolutely square. This operation is continued until all of the rings are cut from the casting. Snap gages are used to gage all of the rings while they are being made on the mill. There is no second machining. The cost of machining, as described, is 6 cents each. Either the Z, L or T-shaped rings may be made with gang tools cheaper than by the method described, but by so doing, the rings cannot be as

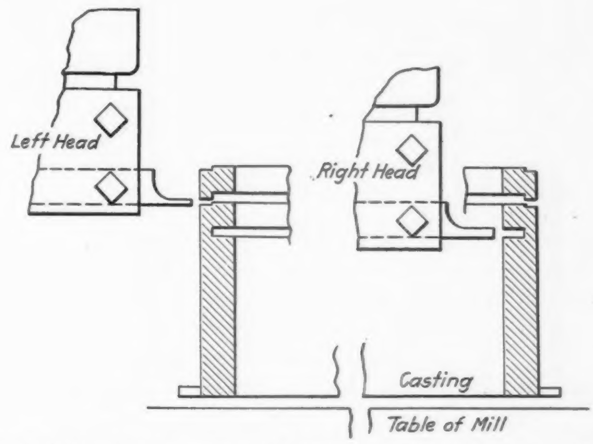


Fig. 2—Method of Cutting Off Z-Shaped Packing Rings for Piston Valves

carefully machined and the saving in engine failures more than makes up for the extra cost of machining the rings one at a time.

We are operating passenger engines 65 miles per pint of superheater valve oil and we have a test engine that has made over 300,000 miles with one set of valve and cylinder packing rings. We average 125,000 miles for valve packing, or in other words, our engines usually run from shopping to shopping. When you consider the expense in the roundhouse for removing and applying valves due to their having been reported blowing, etc., it is well to look into the following suggestions for maintaining valves. The valve rings should not be turned over 1/16 in. larger than the valve chamber, preferably 1/32 in. if the rings are made from good iron and the valve chamber and packing is smooth. If the rings are turned too large for the valve chamber the ring is oval when it is placed in the chamber and bears heavy on two points, causing the locomotive to "blow" slightly; this blow means more lubrication and the burning of unnecessary fuel. In addition to this the ring will cut a shoulder on the valve bushing.

Valve chamber bushings should be bored every time the engine receives general repairs. If it is necessary to renew valve bushings, they should be left small enough so that they can be rebored after they have been placed in position. It is a hard matter on our present two bushing type cylinders to draw them into the chamber exactly parallel, and unless they are parallel the valve will not work freely and this is the cause, in most cases, of so many valve rings being broken. The reason for re-boring all valve chambers at general repairs is that they are always worn at the port ribs and even if it is only slight, so it can hardly be noticed, it will cause trouble. On high speed engines, when

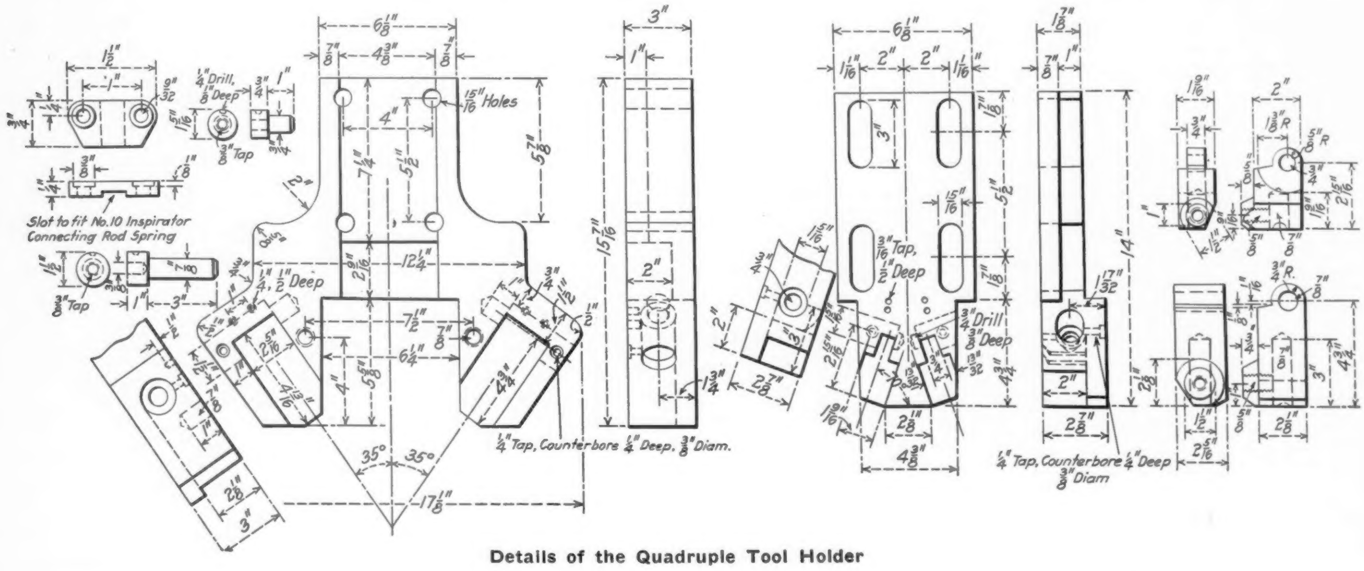
* Entered in the Piston Valve Packing Ring Competition, which closed October 1, 1915.

valves travel very fast, these worn places cause the rings and the valve to jump, which is the cause of most of the valve trouble. If this were followed up more closely a greater saving could be made in locomotive operation.

QUADRUPLE TOOL FOR PLANING SHOES AND WEDGES

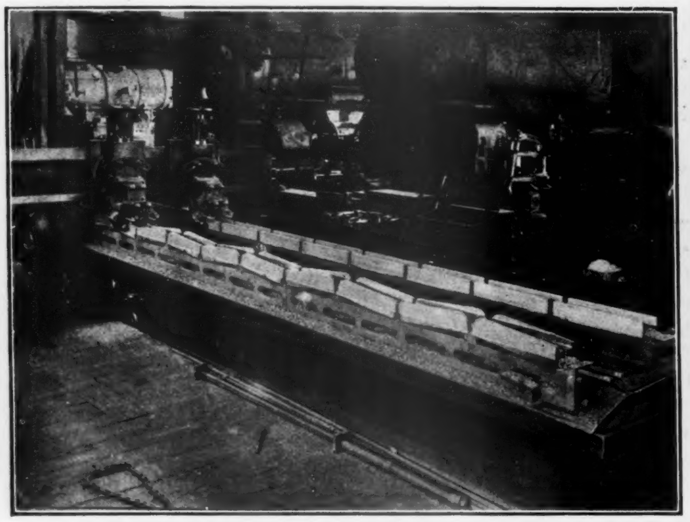
BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The methods used in machining shoes and wedges at the Chesapeake & Ohio shops at this point differ somewhat from ordinary shop practice. Special planer tool holders are used which permit the finishing of the two flanges both inside and outside at the same time, and both shoes and wedges are set up on a chuck which securely holds them and requires very little work in setting and clamping.



Details of the Quadruple Tool Holder

The main head, which fastens on the tool post proper, contains four auxiliary tool posts and four cutting tools. The construction of this head, as shown in detail in the drawing, is in two parts. The part containing the outside cutting tools is secured directly to the tool post of the machine, and above this is placed the part containing the inside tools. The bolt holes in this are slotted for vertical adjustment, thus allowing the inside tools to be raised when finishing wedges. The adjustment of the main head for both shoes and wedges is clearly shown in one of the illustrations, which shows both classes of work set up on one machine.

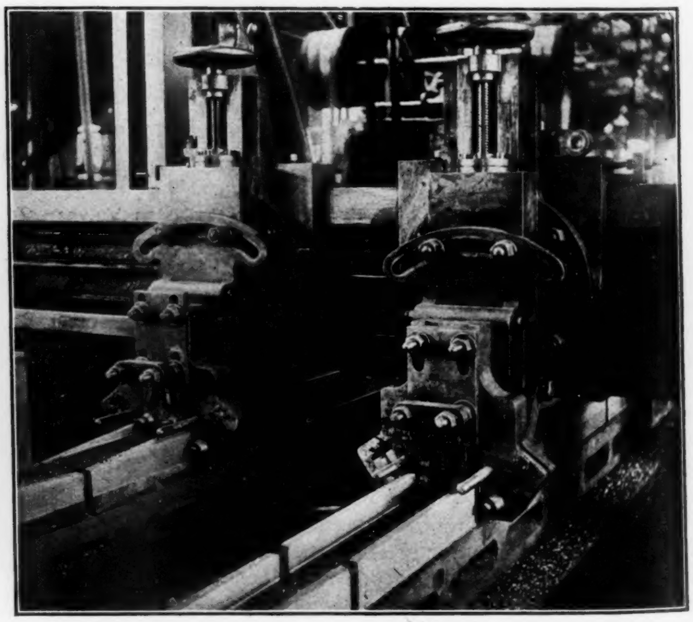


Method of Setting Up Shoes and Wedges on the Planer

It will be noted that the tool post studs extend considerably beyond the face of the special tool. This extension is used to provide a holder for the tool which is used for the purpose of finishing the bottom of the frame fit after the flanges have been finished.

The chucks on which the shoes and wedges are set are box castings on the upper faces of which are placed a number of T-head bolts. These bolts are tightened from the bottom, and the heads are roughened to prevent the ends of the castings which bear against them from slipping when clamped in place by the set screws at the end of the chuck.

This device was developed by a machinist in the shops at this point, and has made it possible to finish cast-iron shoes and wedges at a cost of from six to seven cents each. The work is done on an old Niles planer with a 60 in. by 20 ft. bed, and only one setting is required to finish all but the driving box faces of the castings.



Method of Adjusting Tools for Finishing Shoes and Wedges

STANDARDIZATION OF CRANE MOTORS

At the eighth annual convention of the Association of Railway Electrical Engineers, held at Chicago, October 18-22, a report was made on the standardization of crane motors. The committee, of which H. C. Meloy, New York Central West, was chairman, made a study of the existing conditions of traveling crane equipment in railway shops and found matters in a rather chaotic condition, so far as any attempt at the standardization or uniformity of a motor sizes is concerned. The capacities of the cranes vary from 1 ton to 150 tons, and between these limits there are 25 different sizes. The motor horsepower for the main hoist, bridge and trolley movement for the cranes of definite capacities also showed a great variation.

After carefully analyzing the problem with a view to fully meeting the needs of the modern locomotive repair shops and at the same time reducing the number of different crane capacities to a minimum, the committee suggested the following nine crane sizes, the capacities being in tons: 2, 5, 10, 15, 30 (single and double trolley), 60, 75, 120 (double trolley), 150 (double trolley). The 30-ton, 50-ton and 120-ton cranes each having the double trolley hoist, will actually reduce the number of sizes to the following: 2, 5, 10, 15, 30, 60 and 75. The committee also states: "There may be individual preferences on the part of many engineers for odd sizes of cranes, but it is no trade secret that odd crane sizes specified by railroad engineers usually are made up as a compromise equipment from a few standard sizes, and not always with the best results for either the crane manufacturer or the railroad company."

It would seem that the crane sizes recommended will readily take care of practically all conditions of shop operation, as follows:

2-ton crane for machine bays.
5-ton crane for machine or erection bays, material yard, etc.
10-ton crane for machine or locomotive bays, blacksmith shop, yards, etc.
15-ton crane for the boiler shop.
30-ton crane for the boiler shop.
120 and 150-ton cranes (60 and 75-ton hoist) for locomotive erecting bays.

The committee also made a study of the operating speed of the main hoist, bridge and trolley movements of the various sizes of cranes. From the data obtained from the manufacturers of cranes, the average hoisting speed for the different sizes was found to be as follows:

2 ton	35 ft. per minute
5 ton	30 ft. per minute
10 ton	25 ft. per minute
15 ton	20 ft. per minute
30 ton	20 ft. per minute
60 ton	8 ft. per minute
75 ton	7 ft. per minute
120 ton	8 ft. per minute
150 ton	7 ft. per minute

Regarding the bridge travel speed, the manufacturers commonly employ a formula of 60 lb. tractive effort per ton of weight; this is liberal to allow for inaccuracies in the runway gage, excessive friction, etc. Although the information received by the committee was not complete, the data furnished for bridge traveling speed is approximately as follows:

2-ton crane	150 to 300 ft. per minute
5-ton crane	300 to 350 ft. per minute
10-ton crane	250 to 300 ft. per minute
15-ton crane	250 to 300 ft. per minute
30-ton crane	200 to 250 ft. per minute
60-ton crane	150 to 200 ft. per minute
75-ton crane	150 to 200 ft. per minute
120-ton crane	150 to 200 ft. per minute
150-ton crane	150 to 200 ft. per minute

Trolley or cross trolley speed; 5 and 10-ton cranes, 125 to 150 ft. per minute; 15-30, 100 ft. per minute; 60-75 and 120-150, 80 ft. per minute.

The data for the sizes of the main hoist motors is also tabulated below, but the committee pointed out that it was not to be considered as a recommendation, as further investigation should be made:

5-ton crane	14 horsepower
10-ton crane	22 horsepower
15-ton crane	25 horsepower
20-ton crane	31 horsepower
25-ton crane	35 horsepower
30-ton crane	38 horsepower
40-ton crane	45 horsepower
60-ton crane	57 horsepower
75-ton crane	60 horsepower

The committee did not feel justified in making any definite recommendations, but it is the desire to standardize not only the motor sizes, but the motor outlines, phase templets, motor shafts and key weights. The great advantage of such standardization in crane motors would be the reduction in the number of spare parts to be carried in stock and the greater ease in making repairs or replacements.

START THE APPRENTICE RIGHT*

BY AN OLD-TIMER

Of late years the average apprentice boy who starts an apprenticeship does not do so from the desire to become a good mechanic in his chosen trade, but takes it up simply because it is a "job." Most persons are misplaced because they choose their work in a haphazard way when they start out in life. They and their employers waste years in the "trying-out" process. Starting right is the root of the whole matter. The average apprentice boy is incapable of self-analysis and the best way to help him is to try him out to see if he is really interested, or will become interested as he advances. It is a fact that the first six months of his shop experience is a good criterion of what his conduct will be during his apprenticeship.

There are many ways of stirring up the necessary interest in a boy, chief of which is the extensive apprentice instruction schools, but in a shop which has no special instruction for apprentices I believe the best way to help them succeed is to start them right. By this I mean that some certain good, honest mechanics should be selected to handle every apprentice when he first starts his trade.

Take a young man who starts to work the first morning with a new pair of gloves on his hands and let him work with a good mechanic who has been through the mill and has found out that gloves are not necessary—in fact are a hindrance to accurate work—and it won't be long before the boy will throw his gloves away. This training is invaluable, for once a boy finds he can work without gloves he will never buy another pair. I speak of this one item for I notice that boys to-day are too anxious to keep their hands soft and white, and will sacrifice their reputation for quantity and quality of work to protect their hands. One of the very first things that an apprentice should learn is that he is engaged in labor that will toughen his hands and that a good mechanic can be picked by the condition of his hands.

Another great help to an apprentice boy is to teach him promptness. Take a boy that gets to work at the last minute and gets ready to go home five minutes before the whistle blows at noon or night, and you will find he isn't one of the best mechanics in the shop. I believe an apprentice should be taught to be on time in the morning and do a faithful day's work. Very often we hear the argument that an apprentice gets such small pay that he shouldn't work very hard. When you hear an apprentice talk like that you can safely say that he is not interested in his work.

When I was an apprentice I liked some jobs so well that I could hardly wait for the night to pass to start at the work again. I worked for a foreman who was interested in his work and he seemed to instill interest in me also. Very often we had disagreeable jobs to do, but the foreman would come around with a smile and tell us the quicker we completed the hard job the quicker we would get a better one. By these methods our foreman was known as a "real" man, for he had a kind word for everyone.

This suggests the thought as to how an apprentice should be

*Entered in the prize competition on "How Should Car Inspectors Be Trained and Developed, and What are Their Qualifications?" which closed October 1.

treated by his superior officers. The best way to help and encourage a boy is for the general foreman or shop superintendent to occasionally speak to him in the shop and question him about his work. Boys look on their superior officers as the "great" men of the shop and when the boy finds out that he is noticed he will try all the harder to support his officers. Take, for instance, the study of shop accidents. Many serious accidents can be traced directly to some careless workman, so why neglect your young coming mechanic and let him get into careless habits? I say that the time of a general foreman or shop superintendent cannot be put to any better advantage than by giving the young apprentice a short talk on safety ideas. We would be very proud to have the President of the United States stop us on the street and converse for a few minutes, and the average apprentice holds his shop superintendent in the same esteem as we do the President.

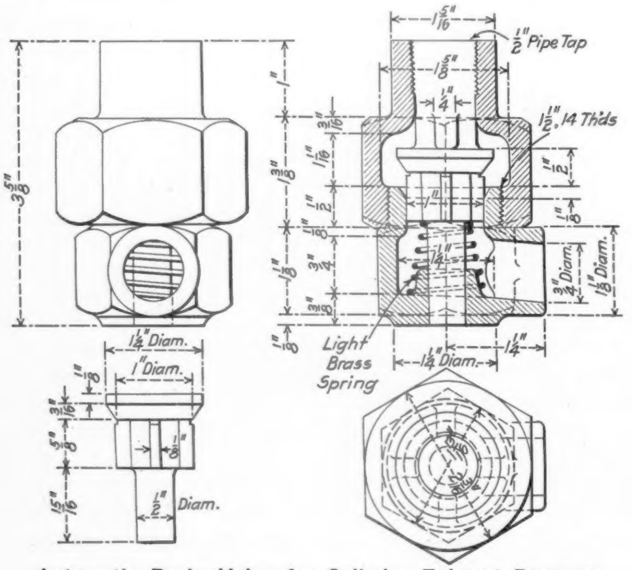
Another great help is to change the boy frequently from one class of work to another so that he will not go "stale." A young man who is very active picks up ideas rapidly, in fact, quicker than we realize, and in order that he will not lose his interest, I believe he should be changed from one department to another frequently. The benefits from this system are many, for if the boy does not catch on quickly, he is not interested, and if not interested, will make only an ordinary mechanic.

Another benefit of this system is that the boy will cover the ground long before he has completed the required time of his apprenticeship, and can be tried out alone on a job. The real test of a good mechanic is the way he handles his work and while a boy may be a perfect apprentice, he may be a failure as a mechanic when he is placed on his own resources. The best way to help the older apprentice is to let him work alone, or give him a helper and try him out on regular mechanic's work. An apprentice will not have some experience on every class of mechanical work while serving his time; as an apprentice he is taught only the simple rules of his trade. To be a successful mechanic he must learn to use his head and to keep his eyes open.

In summing up, if the boy is started right and is taught to observe things and is treated like a man, it is the best and only way to help him become successful in his chosen trade.

EXHAUST PASSAGE DRAIN VALVE

The illustration shows a simple automatic drain valve for use in cylinder exhaust passages which was developed by A. L.

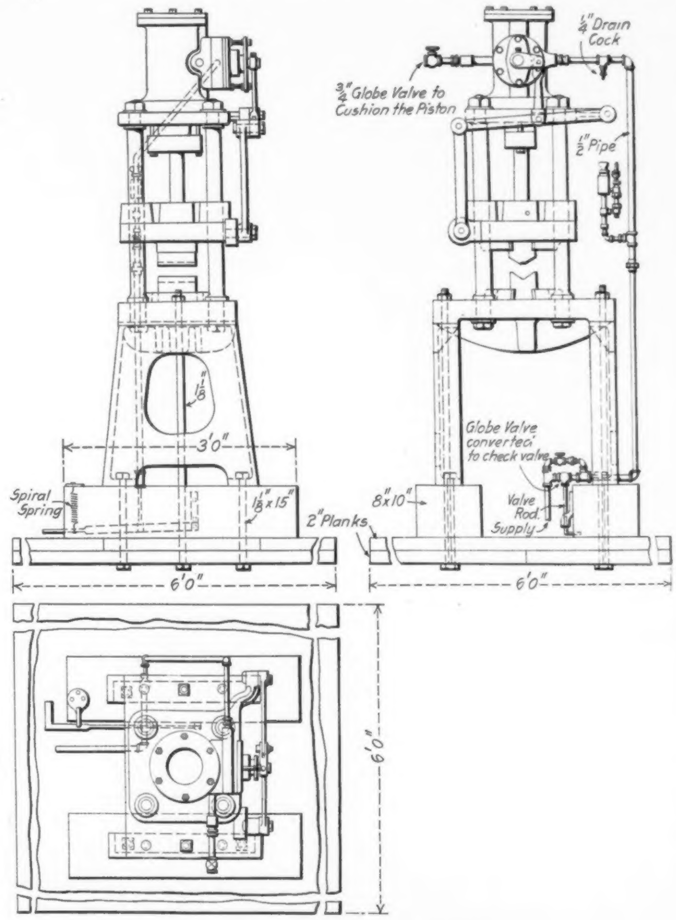


Automatic Drain Valve for Cylinder Exhaust Passages

Graburn, mechanical engineer of the Canadian Northern, Toronto, Ontario. The body of the valve consists of two sections the upper one of which is attached either to the wall of the cylinder casting or to a pipe connecting it with the exhaust passage. Into this is threaded the other section which contains the outlet from the valve and a coil spring of light brass wire just strong enough to lift the check valve from its seat but permitting it to close positively under steam pressure. The valve has a lift of about 3/8 in., which is limited by lugs cast in the upper part of the top section of the casing. The valve is guided by a 1/2-in. stem passing through the lower part of the casing and also by four wings just under the valve disc.

PNEUMATIC HAMMER

An ingenious and serviceable air hammer has been devised by William Baird, shop superintendent of the Plattsmouth, Neb., car shops of the Chicago, Burlington & Quincy, for welding bolts and for hammering out scrapped rods to rods of smaller diameter. The photograph shows one of these hammers located adjacent to a furnace and used for welding bolts. At the base



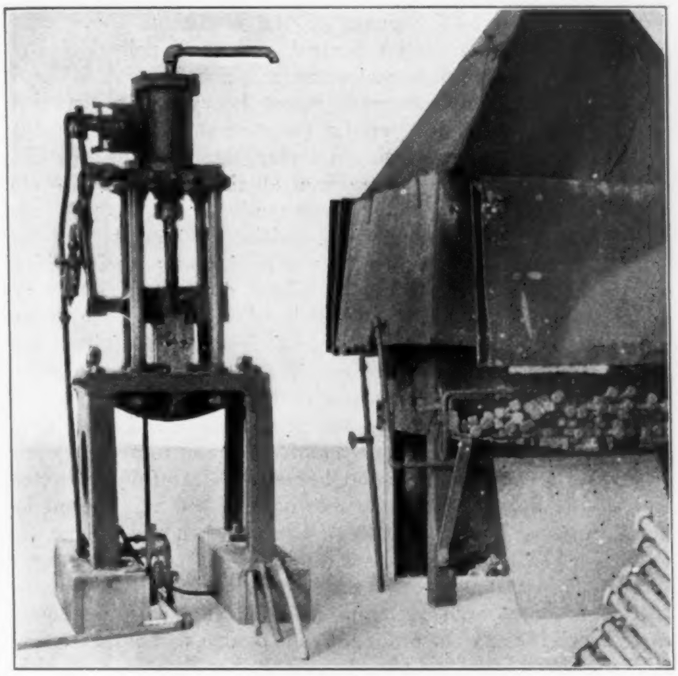
Pneumatic Hammer Assembled

of the hammer, resting against a pillar block, may be seen the two pieces of a bolt before it is welded and a finished bolt. The iron is scarfed in the cutting and the heads are heated in one side of the furnace and the ends in the other. They are simultaneously removed by the operator and his helper, placed in the proper position under the hammer and welded. The hammer operates at a speed of 250 strokes per minute and 650 bolts are welded in an eight-hour day. Bolts from 7/8 in. to 1 1/4 in. are handled in this machine.

The construction of the machine is shown in the drawing. The cylinder is supported on four columns, 2 1/4 in. in diameter. These columns are bolted to an anvil block 18 in. by 28 in. by 3 in. thick, which is reinforced with a 3-in. rib. running length-

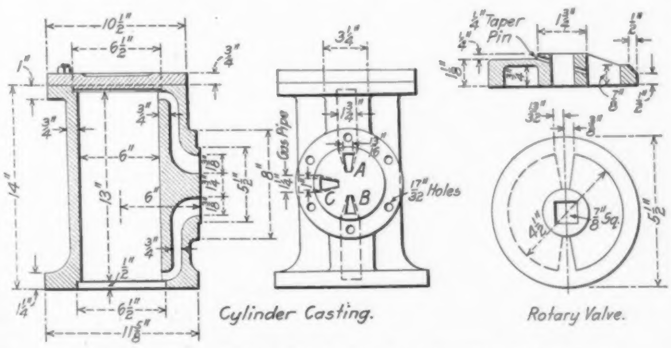
wise of the block. This block rests on a cast-iron frame, which in turn is bolted to two pillar blocks, 8 in. by 10 in. These blocks are again bolted to a base 6 ft. square made up of two courses of 2-in. planks.

The cylinder has a bore of 6 in. and provides for a stroke of about 10 in. The piston is 2⅝ in. thick, being designed for three



Pneumatic Hammer for Welding Bolts

packing rings ⅜ in. thick. The piston rod is 2½ in. in diameter and has a taper fit in the hammer. The air supply to the cylinder is regulated by a rotary valve, operated by the link motion shown in the side view of the hammer. The valve itself is also shown among the details of the machine. It has one blind and one open chamber which alternately cover the ports *A* and *B*, shown in the side view of the cylinder. The port *C* is the exhaust and is constantly under the blind chamber of the rotary valve. Air is admitted to the cylinder from the valve chest through the open



Cylinder and Rotary Valve for Pneumatic Hammer

chamber and the ports *A* and *B*. The exhaust pipe is provided with a globe valve for the purpose of restricting the exhaust sufficiently to give a cushioning effect to the piston at the end of the stroke. The air to the valve chest is controlled by a pedal valve at the base of the machine. This valve is by-passed for the purpose of keeping a constant pressure under the hammer, thus holding it in its "up" position when it is not working.

EFFICIENCY OF SMALL TURBINES.—The highest commercial efficiency of small steam turbines is said to be about 40 per cent.

ENGINE FAILURES, THEIR CAUSES AND CURE

BY J. E. ANDERSON

General Foreman, Erie Railroad, Susquehanna, Pa.

I have read with much care and interest the report on round house efficiency presented at the General Foremen's Convention recently held in Chicago, which concludes by stating that, "perfect organization in a round house is the cure for engine failures." A great many exhaustive articles on the prevention of engine failures have been written and it has always been standard practice to place the entire blame for all failures on the engine house foreman; and many a man holding this position and possessing exceptional ability has been retired, due to his inability to overcome engine failures which he was in no way responsible for and which continued with uninterrupted regularity long after he ceased to exist as a foreman. The reason for placing the blame on the engine house foreman is perfectly natural from a transportation department standpoint, due to excessive delays to trains on the road, caused by engine failures, which result in endless confusion and expense to that department and for which there is no apparent excuse whatever.

Visualize for a moment a busy division on a trunk line handling heavy traffic, and consider what it means when the road is lined with trains to have an engine break down at a point where it is liable to tie up traffic for hours. The effect is demoralizing and the loss to the company heavy, due to large amounts paid for overtime to the engine and train crews affected. Where passenger trains are seriously delayed and important connections missed, there is a loss in business that cannot be computed. A passenger who has suffered on account of delays of this nature will not only refuse to take a chance on that line again, but is apt to advertise his experience to others and this is bound to affect the ticket sales. The failure is known to everyone from the president down, and since the engine is supposed to be maintained in the round house, it was evidently dispatched in an unserviceable condition by the engine house foreman; he is therefore naturally looked upon as the guilty man. While we are prepared to admit that a clear engine failure board means that there is a perfect round house organization behind it, a perfect round house organization does not necessarily mean a clear engine failure record. As a matter of fact, it is possible to have a thoroughly efficient engine house organization, and yet be constantly confronted with numerous engine failures, and if the master mechanic referred to in a recent editorial in the *Mechanical Edition*,* who stated that 99 per cent. of the failures on his road were due to his round house organization, was literally stating a fact it must be assumed that the many other conditions which usually contribute to failures, over which the round house has no control, do not exist on his road, and if this is the case, he ought to recognize the importance of applying a remedy, as he alone is responsible. He is in supreme command of his engine houses, and tolerating an imperfect organization is equivalent to admitting his own inability to perfect it.

One of the causes leading up to engine failures, which exist to a greater or less extent on most of the railroads, for which the engine house foreman should not be held responsible, is the pooling of power, and running engines first in, first out without an assigned engine crew; compelling the foreman to keep them going and criticizing him for not turning engines promptly on arrival. This is extensively practised on many roads, and some of them have fixed a time limit of two and one-half hours from the time engines arrive on the ash pit until again attached to a train. Oftentimes, when an engine has made a successful run over the division and the despatcher sees that it will arrive at about a certain time, he will notify the engine house of the fact, and instruct that a fresh crew be called to

* **Editor's Note:** The editorial referred to appeared on page 395 of the August, 1915, *Railway Age Gazette, Mechanical Edition.*

take the engine back immediately on arrival. If the foreman hesitates, the case is explained to the master mechanic, who advises the foreman to get busy and hurry the engine out. It is difficult to see how any round house organization can exercise a restraining influence on engine failures when methods of this kind are followed. Again, it is a common practice on many roads for train masters and general yard masters, when ordering power of the engine house and not getting it at just the hour demanded, due to important repairs that the foreman deems advisable, to wire the superintendent the numbers of the engines held which are refused by the foreman, omitting, however, to give the reason for holding them. The result is that the master mechanic's office is advised of the dilatory conduct of the foreman, who is immediately wired by his department that the orders for power must be filled at once. The 100 per cent round house organization will not act as an engine failure deterrent under such conditions.

Another prolific case for non-performance of engines is traceable to the back shop. The enterprising shop superintendent being saturated with a desire to boost his shop output and incidentally beat his predecessor's record for engines overhauled, engines are taken into the shop, hurriedly gone over, given a part set of flues, the rods, motion work, and driving boxes refitted, the tires turned, the engine painted and returned to service to start new mileage. No attention is given to truing up the journals or crank pins, valve chambers or cylinders. The frames are not touched and a score of important operations that should never be ignored are allowed to go undone. The round house getting these engines has its work cut out for it in keeping them off the failure board.

Lack of co-operation on the part of the road foreman is another cause for a class of failures that never would occur with the right man on the job. By keeping the engine house foreman posted on engine performance and by educating the younger men to get over the road under adverse conditions many failures may be avoided.

Nothing is more conducive to engine failures than the loss of the engineers' support, brought about usually by persistent nagging over trivial offenses. Disciplining a man for an error in judgment, or omitting to perform some duty of an unimportant character, is sowing the seed of discontent among a class of men that can work more harm to the mechanical department of a railroad than any other one cause. The writer distinctly recalls a case of an engineer who had some grates burned out, and seeing a chance to get some fish plates from a section house, secured the material required, made temporary repairs and brought in his train without a failure. The case was reported by the road department, investigated and the engineer suspended for ten days. I never heard of any further effort on his part to prevent failures, but I did hear him boast of one he had which tied up his road for hours, and which there is reason to believe he could have avoided. The engineer is master of the situation after leaving the terminal, and the better satisfied he is with his working conditions the greater exertion he will make to keep down failures.

Another frequent cause for charging failures is due to the overloading of engines on long and hard divisions under bad weather conditions by the transportation department, the failure being charged to avoid a violation of the sixteen-hour law. The use of material of a poor grade is often the cause of failures of a disastrous nature. Weakness in the design of parts is another cause of numerous failures for which the foreman is more or less criticized.

Possibly no one thing has a more disastrous effect on round house organization than a lack of harmony between the master mechanic and the engine house foreman. The master mechanic who has not served as engine house foreman himself cannot appreciate what it means to hold that position, and is apt to have a pessimistic view of things in general in the round house. Conditions in the round house often change within a remarkably short space of time from perfect order to a complete state of chaos, due to any one of a score of unexpected occurrences which the engine house foreman must be big enough to meet. Such conditions are unknown in a back shop, and the man who receives his training in the back shop naturally has but little sympathy for the irregular operations in the round house.

Remarkable results have been obtained on the Erie Railroad in eliminating engine failures. These results are due, in the first place, to a total absence of the conditions above noted which the formean cannot control, and to a policy of rigid inspection and thorough maintenance which is carried out at all times. Unlike some roads where heavy traffic conditions are not constant, which permits the mechanical department to prepare for the heavy business during slack periods, the Erie handles a heavy volume of traffic at all times, and it is imperative that power be maintained constantly at the highest point of efficiency. The Susquehanna division, 140 miles long and handling the heaviest traffic on the road, has a record of 75 days without a passenger engine failure, during which time approximately 200,000 miles were made. During the same period, a record of 38 days with but one freight engine failure was made, representing 250,000 miles. These results have an added significance when it is understood that the rules governing what constitutes an engine failure are much more rigid than those laid down by the various state and federal governments. When an engine arrives at the round house, it is carefully inspected, and repairs made before it is returned to service. The engine house foreman is the man who decides when the engine can go, and as he is held wholly responsible for its performance it is of vital importance to him to know that it is in serviceable condition before allowing it to go. All engines are assigned to regular crews; if at times it is impossible to hold an engine until the crew have had their rest, they are deadheaded to the other end of the division for the engine. In each roundhouse there is a framed list of instructions, consisting of 53 operations which are performed at boiler wash periods. These are extraordinary inspections such as crosshead fits, valve and cylinder packing, removal of all trailer and tank wheel bearings, removal of drawbars and pins, testing superheat units, etc. In addition, a special inspector goes over the engine and reports in detail his findings. Each class of the work is handled by specialists. Each operation is recorded in a book for the purpose by the man in charge of the work. This enables the foreman to keep in touch with what is being done at all times, and gives him a line on what material is being used and if excessive amounts, it is seen at a glance and steps taken to correct the bad condition.

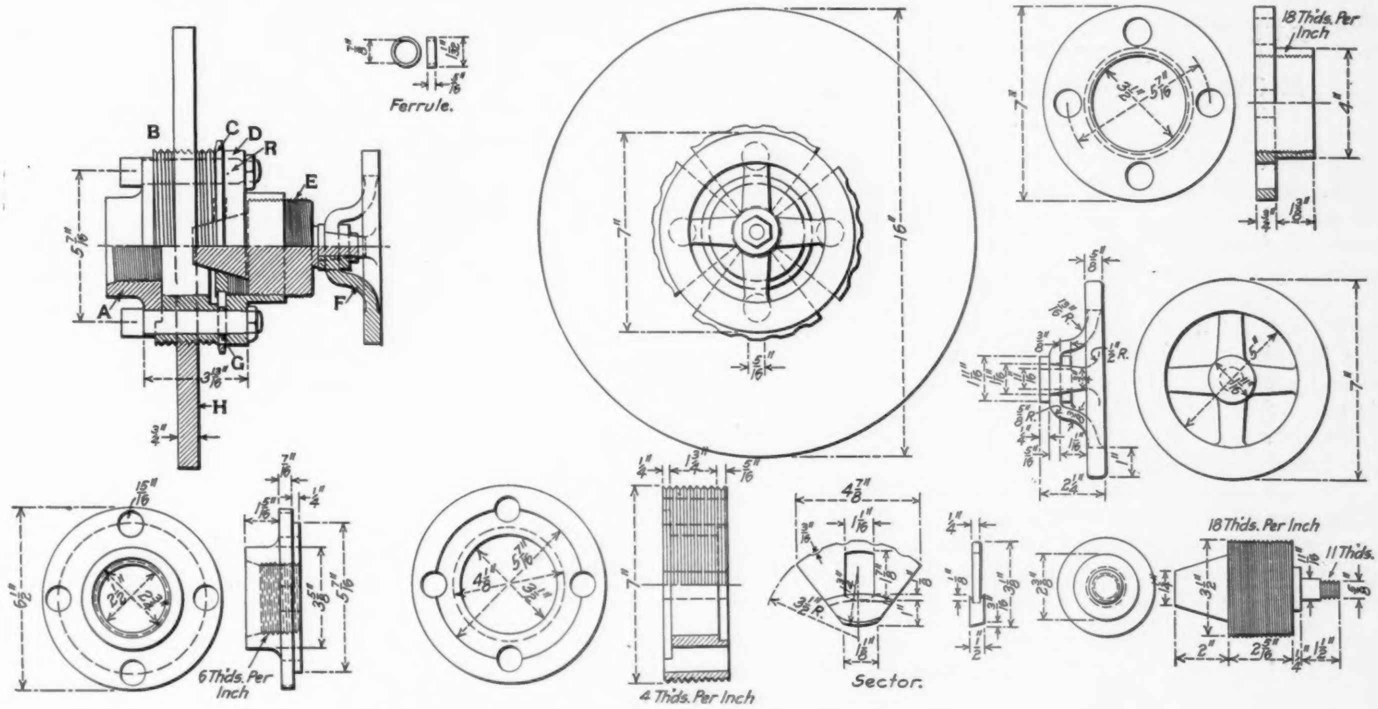
Engineers know that their engines will be held at these periods, and figure accordingly on the work they want done. When repairs are completed, the engine under ordinary circumstances can be relied upon for the rest of the month, and can be turned, usually, as promptly as required. As all engines taken in the back shop are given a thorough overhauling down to the smallest detail it is possible to obtain exceptionally high mileage between shoppings.

Storing Steam at the Engine.—Storing steam at the engine instead of at the boiler was accomplished by placing large receivers and separators near the throttles of reciprocating engines recently installed in the power house of a western mining company. At the same time the boiler drums installed at the plant were made unusually small, as the company's engineer declared that the proper place to store steam is at the engine throttle and not in the boilers. The receiver capacity at each engine is practically four times the cylinder capacity, and this steam reservoir permits the use of smaller steam piping, thereby reducing heat losses and establishing at the same time a reserve supply of dry steam immediately at the engine throttle, where it is most needed under the condition of an engine engaged in mine hoisting.—*Electrical World.*

CHUCK FOR FINISHING AIR PUMP PACKING RINGS

BY F. R. STEWART

There are a variety of opinions as to the best method of finishing packing rings. Some consider grinding on a magnetic chuck to be the only proper way to insure a true face, others claim that facing one side at a time in a split bushing gives the best results. From a close observation of both methods it will be found that the chucking of the casting from which the rings are cut necessarily distorts it, and after the rings are cut off, with a fraction of an inch of stock for finishing, the chucking strain is relieved and the result is a warped ring, If this ring be drawn down and faced on a magnetic chuck the same warp will appear when the influence of the chuck is removed. The principle is exactly the same if the ring is crowded into a split bushing and faced. When the holding force of the bushing is relieved the ring will be more or less warped and will rock on a face plate.



Chuck for Finishing Both Sides of Packing Ring at the Same Time

The drawing shows a device which overcomes these difficulties by facing both sides of the ring at the same time, and any irregularities in the ring are faced off without chucking strains. Referring to the sectional view of the assembled jig, plate *A* fits the spindle of the lathe, and to it the parts *B*, *C* and *D* are bolted by means of the fitted bolts *R*. Segments *C* are free to move on the steel ferules *G*.

The operations necessary to chuck a ring are as follows: Revolve face plate *H* on disc *B* to square up the packing ring, which is placed over the four segments *C*. Tighten the ring by turning the wheel *F* clockwise. When the packing ring is sufficiently tight, start the lathe, and back the face plate toward the head stock of the machine; this will allow both inside and outside faces of packing ring to be cut at the same time by means of a forked tool. The segments are so constructed that their width is 1/16 in. less than the finished width of the packing ring.

The face plate can be made large enough to include the largest size ring, it being only necessary to have a set of segments for each inch increase in packing ring diameter. On this jig from 200 to 250 rings can be faced in 10 hours, and every one will gage perfectly at any position.

MACHINE TOOL LUBRICANT PUMP

An interesting arrangement in use at the Sedalia (Mo.) shops of the Missouri, Kansas & Texas for pumping lubricant to the various machine tools for use in cutting operations is shown in the photograph. The pump consists of two air brake cylinders

Pump for Machine Tool Lubricant

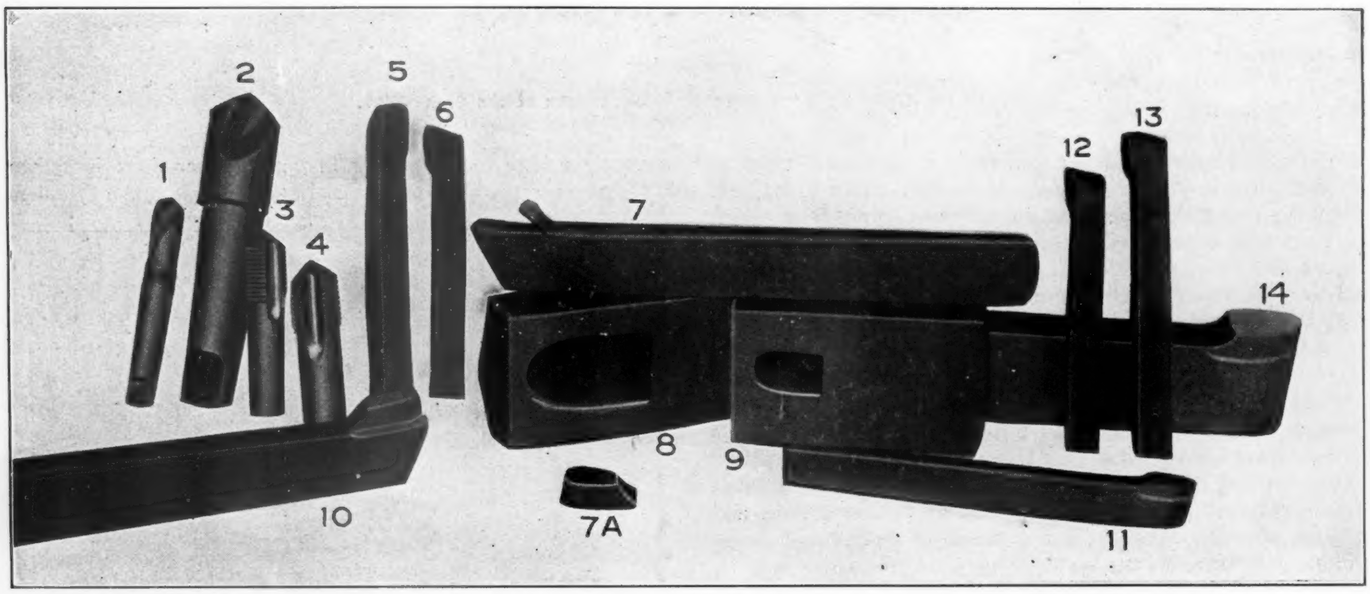
placed back to back. They are actuated from the shop air line system, which delivers the air through a three-way cock to the

upper part of the cylinders. As the pressure is applied the piston descends, forcing the lubricant through the lubricating system. The piston in the other cylinder being connected by a chain over a sheave to the descending piston rod is drawn to its upper position and at the same time draws in a charge of lubricant. The air valve is actuated by a rocker on which a revolving weight travels, which, as the arm is raised, by a contact on the sheave, throws the valve over to either extreme position, admitting the air to one cylinder and releasing it from the other. The system is entirely automatic, inexpensive to make, and has given good results.

HIGH SPEED STEEL TIPPED TOOLS

At the recent convention of the Tool Foremen's Association, J. W. Pike, tool foreman of the Chicago, Rock Island & Pacific, at Silvis, Ill., spoke of the success that had been attained at Silvis by welding high speed steel tips on shanks or holders made of axle or tire steel and sometimes old taps and dies. In the latter case the twisted portion of the drills and the threaded portion of the taps are heated and hammered to the proper size and shape. The tools 5 and 6 in the accompanying illustration are made from drills, and tools 12 and 13 are made from old taps; in both cases these tools are not finished. The drills and taps 1, 2, 3 and 4 are to be made over into high speed steel tipped tools.

The high speed steel tip is shown at 7 *A*. The tips are made in the dies 8 and 9. The impression in the dies is stamped under the hammer with a piece of steel shaped to the required size, the die blocks being heated sufficiently to be easily depressed under the force of the hammer. The body of the tool ready to receive the tip is shown at 7. A lip is prepared, as shown, to hold the tip in place while the welding heat is being taken, which is about 2,200 deg. The tip and the tool body are then pressed together until they are thoroughly welded. A 1,500-lb. hammer, a bulldozer, a forging machine, or a hydraulic press can be used, or any other means that will quickly give sufficient pressure to hold the tip firmly onto the body of the tool until fusion has taken place. It is found necessary to use a flux, and the E-Z welding compound has proven satisfactory. The finished tool, after being ground, is shown at 14. Nearly all kinds of machine tools can be made in this manner, such as tools for lathes, planers, boring mills, etc., from 1 in. by ½ in. to 2 in. by 3 in., but it has not been found practical to make the parting, threading and turret lathe tools in this way. By following this method the cost of tools has been materially decreased.



Group of High Speed Steel Tipped Tools with Dies for the Tips and the Tool Shanks

TEMPERING TOOLS WITH THE ELECTRIC FURNACE

The committee on Shop Practice of the Association of Railway Electrical Engineers, in its report at the last annual convention, strongly favored the use of the electric furnace in tempering tools, claiming that the life of the metal would be increased because of the ease with which it is possible to control and determine the temperature of the electric furnace. Regarding the cost of tempering by this means the committee reported as follows:

These costs are an average obtained from several different shops taken independently of each other and then compiled; although an average is used, in no cases were the limits of high and low costs greater or less than 10 per cent from each other. It will also be understood that costs of air are based on an electric-driven blower, current costing two cents per kilowatt hour and on such tools as require more than one heat to work them this is taken into account in determining the unit price.

DIES

Size	Softening	Labor to increase size	Retempering	Total
½ inch to ⅝ inch	.0383	.10	.041	$.1793
⅝ inch to ¾ inch	.0378	.112	.04	.1898
¾ inch to ⅞ inch	.0371	.121	.04	.1981
⅞ inch to 1 inch	.0365	.142	.038	.2165
1 inch to 1⅛ inch	.031	.161	.038	.23
1⅛ inch to 1¼ inch	.031	.164	.038	.233

In making these figures, machinists' labor costs are assumed to be 40 cents per hr. and the blacksmiths' labor at 39 cents per hr.

TAPS

Size	Softening	Labor of dressing	Retempering	Total
1⅛ inch to 1 inch	.0423	.123	.0542	$.2195
1 inch to ¾ inch	.041	.119	.0540	.214

MACHINE TOOLS

Size	Labor of dressing	Tempering	Total
Small	.0633	.043	$.1073
Large	.0825	.052	.1345

Very little information was obtainable on these.

CHISELS

Size	Labor of dressing	Tempering	Total
Small	.041	.032	$.073
Large	.063	.052	.104

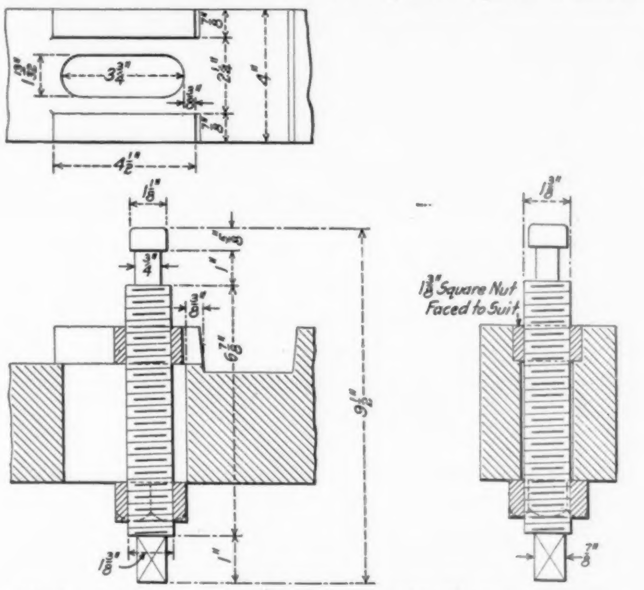
The last two items are usually of the best steel, and it is necessary often to make more than one heat to work them;

some of the costs collected under the head of "Chisels" are considerably higher than those given.

REMOVABLE WEDGE BOLT

BY H. E. OPLINGER
General Foreman, Atlantic Coast Line, Brunswick, Ga.

A simple removable wedge bolt designed by the writer and intended to permit the removal of the wedge bolt without taking down the pedestal binders, is shown in the drawing. The device consists of the bolt and two nuts, and requires a binder



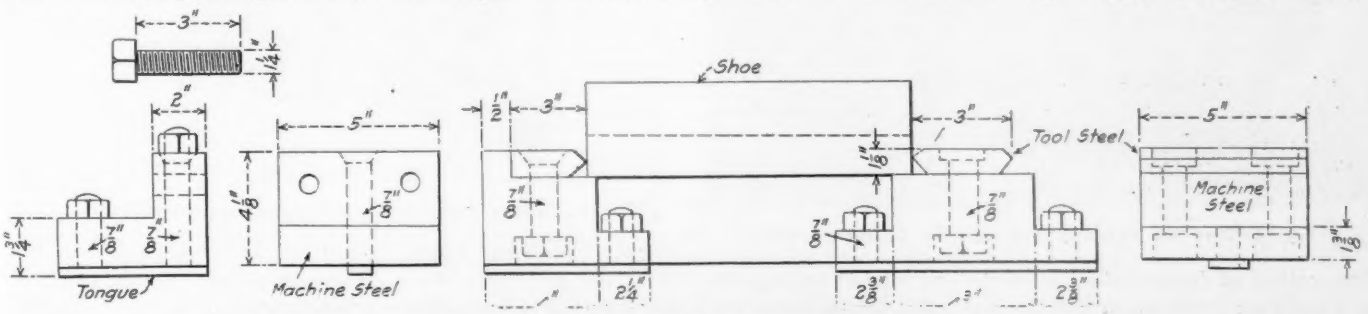
Wedge Bolt Which May Be Removed with Binders in Place

on the upper side of which are two shoulders, one on either side of the slot through which the bolt passes. The bolt engages the wedge in the usual manner and is secured in place by means of a special square nut which sets between the shoulders on the binder and an ordinary nut below the binder. The wedge is adjusted by slacking off the lower nut, when the bolt may be raised or lowered by turning it through the upper nut and is again locked in place by tightening up the lower nut. The bolt may be removed by sliding it out of the wedge and then screwing it out of the upper nut, the body of the bolt being threaded throughout its entire length.

SHOE AND WEDGE CHUCK FOR MILLING MACHINE TABLE

BY R. E. BROWN
Machine Shop Foreman, Atlantic Coast Line, Waycross, Ga.

The drawing shows a set of jaws in use on the milling machine table for clamping driving box shoes and wedges. The set consists of five pieces and is designed to secure two shoes or wedges on the table for finishing at one time. By increasing the number of intermediate pieces, however, the set could be made to take any number of castings.



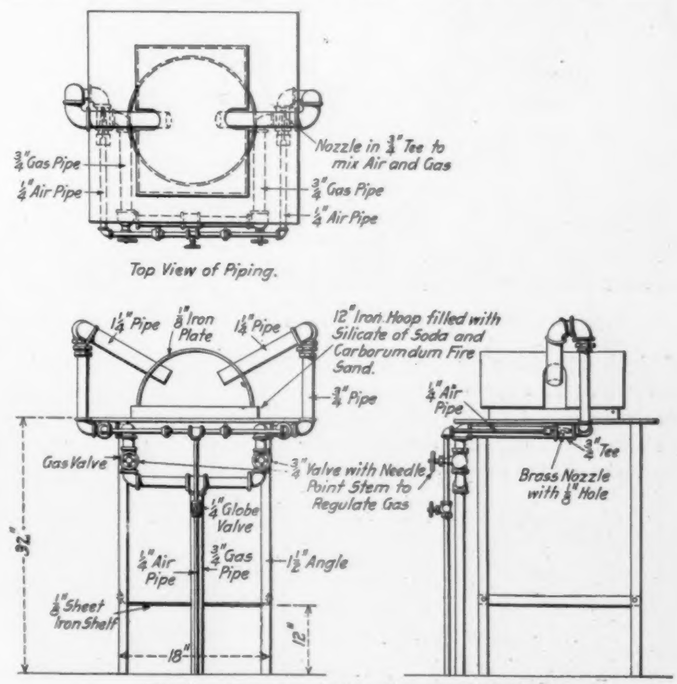
Tool Steel-Faced Jaws for Clamping Shoes and Wedges on Milling Machine Table

The intermediate piece is bolted to the table and securely clamped, the end jaws being adjusted to suit the length of the shoes or wedges. The ends or angle pieces are placed close to the end jaws and are clamped to the table as tightly as possible and further secured by placing stop pins behind them. Set screws passing through the vertical walls of these pieces bear against the back of the end jaws and press the tool steel jaws into the ends of the castings.

Owing to the fact that this work is done on a light machine in the Waycross shops, but two castings are set up at one time, our experience having shown that we can do the work quicker in this way than by setting up six castings at once. On a heavy milling machine, however, if two rows of these chucks are used shoes and wedges may be finished from 3 to 4 cents each at a machinist rate of 41 cents an hour. In milling wedges one end of each wedge is raised by placing a block under it.

GAS BRAZING FURNACE

The drawing shows a neat home-made brazing furnace used by the Chicago & North Western at the Clinton shops, in which commercial gas is used as the heating agent. The furnace is 32 in. high, being made of 1½-in. angle iron with a sheet



Brazing Furnace Using Commercial Gas

iron top and a sheet iron shelf 12 in. from the bottom. The gas is fed to the furnace through a ¾-in. gas pipe, the flow being regulated by a needle valve. The air used for mixing with the gas is taken from the shop line through a ¼-in.

pipe, and is admitted to the gas line through a nozzle in a ¾-in. tee, shown in the top view of the furnace. The blast which, as shown, comes from both sides of the furnace, is directed on to a bed of a mixture of silicate of soda and carborundum fire sand. A ⅛-in. curved iron plate forms the hood of the furnace, the ends being left open. The furnace is inexpensive to build, and has been found to work very satisfactorily where city gas is used in the shops.

HANDLING COUPLER YOKES

The photographs show three machines used for coupler yoke work at the Plattsmouth, Neb., shops of the Chicago, Burlington & Quincy. They are noteworthy because of the fact that but for their present use they would have been scrapped. An

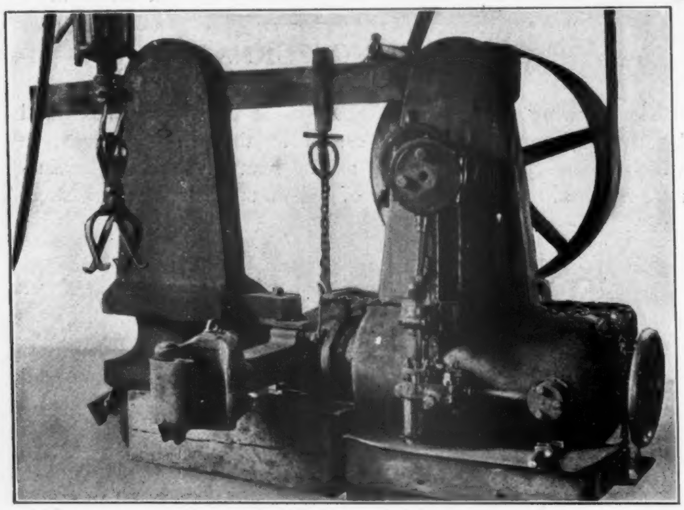


Fig. 1—Hydraulic Press for Removing Coupler Yokes

old hydraulic wheel press that has outlived its usefulness as such, and which is used for removing the yokes from couplers, is shown in Fig. 1. The yoke bears against a forked head in the outboard housing, and the plunger of the press pushes against the body of the coupler, thus shearing the coupler yoke rivets.

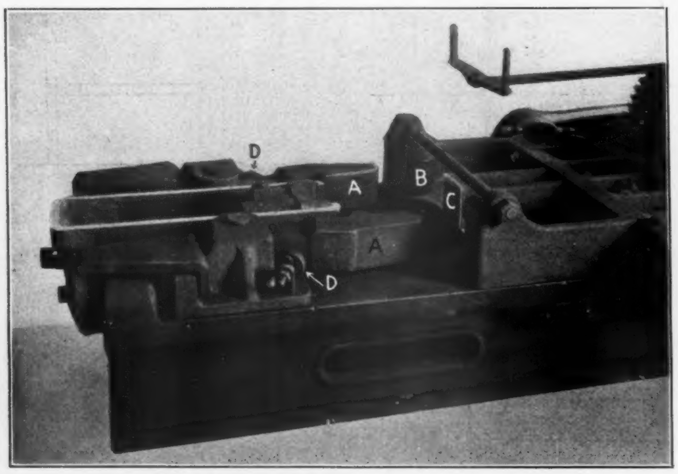


Fig. 2—Dies for Forming the Lips on Coupler Yokes

The method of forming the lips on the end of the coupler yoke in a bulldozer is shown in Fig. 2. The yoke, having been bent, is anchored to the bed of the bulldozer within the arm, *A*. As the head of the bulldozer travels forward, the rollers *B* force the arms *A* against the yoke, thus forming the lips. The plunger *C* shears the lips to the proper length. Both operations are performed with one stroke of the head. The arms *A* are held in the open position by the springs *D*.

The machine used for riveting the coupler yoke to the coupler is shown in Fig. 3. It is a pneumatic riveter set into the floor

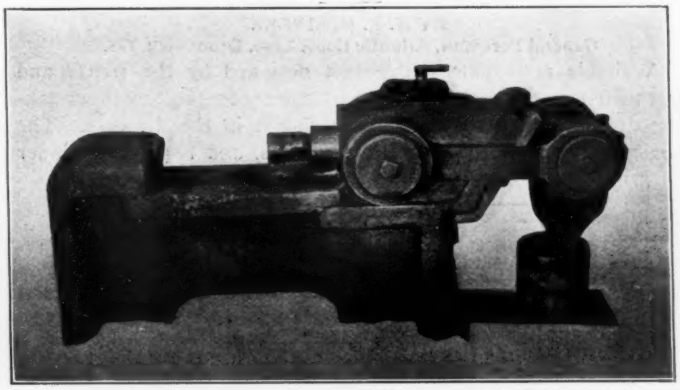
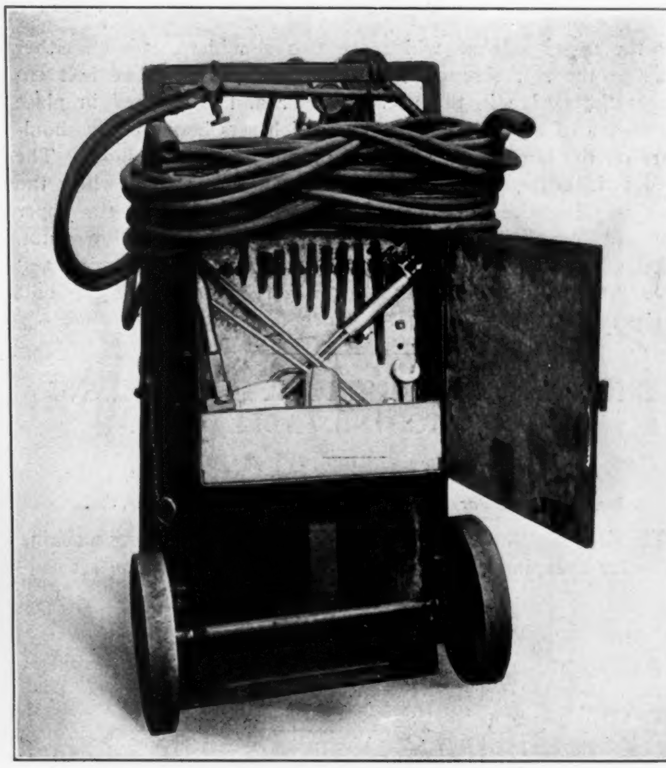


Fig. 3—Pneumatic Riveter for Riveting Yokes to the Couplers

of the shop as indicated and is operated by a three-way valve, shown just above the plunger cylinder.

PORTABLE OXY-ACETYLENE WELDING AND CUTTING OUTFIT

A truck for handling the oxygen and acetylene tank, and a cupboard containing the various tips, burners, wrenches, etc., used in oxy-acetylene operations in and about the shops of the New York Central Lines at Elkhart, Ind., is shown in the photo-



Complete Portable Welding and Cutting Outfit

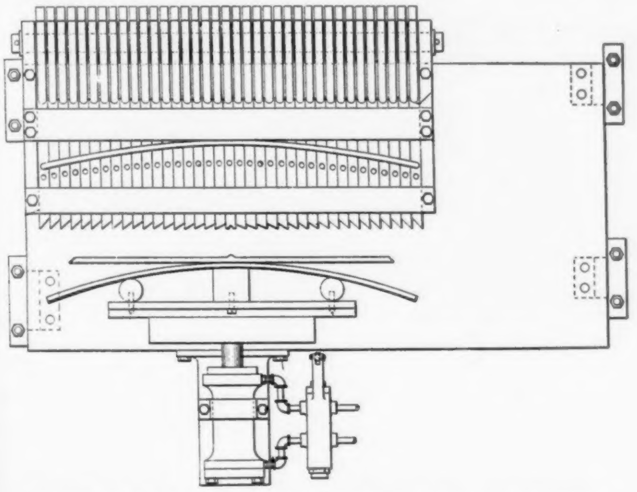
graph. Everything that is needed for the work is carried with the truck, and there are no delays occasioned by operators being required to leave their work in search of necessary articles. The two tanks are set in the frame work of the truck and clamped in position. The handles are made of pipe and extend from the front of the tank rest diagonally across the frame of the truck. When not in use the hose is coiled around the handles.

NEW DEVICES

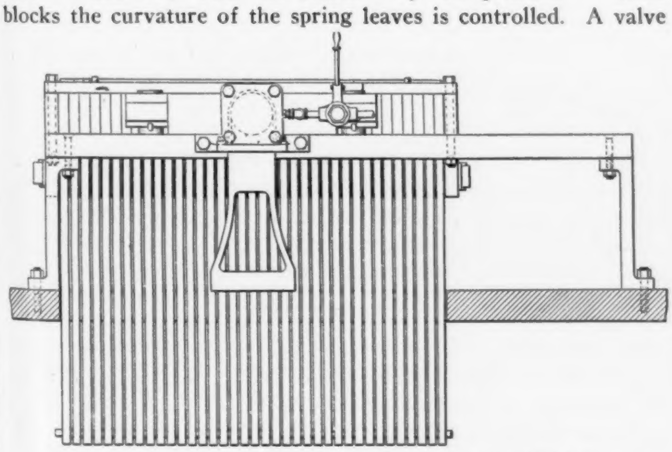
UNIVERSAL ELLIPTIC SPRING FORMING MACHINE

A Universal elliptic spring forming machine has recently been placed on the market by Jos. T. Ryerson & Son, Chicago. It is designed for railway spring shop use and will form elliptic spring leaves of any size and curvature within the limits of ordinary practice without changing dies.

The body of the machine is a heavy horizontal table supported on five legs. On one side of this table is a bank of keys which form the concave die against which the spring plates are shaped. The keys rest on edge side by side and are held in their forward positions by a series of counterweight levers which provide the necessary pressure to bend the hot plates. On an extension across the table from the keys is a pressure cylinder, a crosshead on the front end of its piston rod acting as the convex die. On the face of this crosshead are mounted three blocks, the center block being stationary and the others adjustable in and out from the center. By the position of these blocks the curvature of the spring leaves is controlled. A valve for controlling the movement of the piston is placed immediately above the cylinder when compressed air is used and at the side of the cylinder when hydraulic pressure is used.

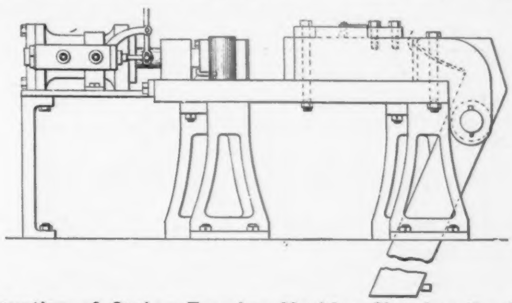


Plan of the Universal Elliptic Spring Forming Machine



View of the Cylinder Side of the Spring Machine

In operation the hot leaf to be formed and the cold leaf against which it is to fit in the completed spring are placed on edge on the table with the cold leaf against the crosshead. Pressure is then applied to the piston until the two leaves are forced against the bank of keys, when the hot leaf will be bent to the exact curvature of the cold one as a result of the resistance offered by the counterweighted dies. If camber or tuck is desired between the leaves the two adjustable blocks on the crosshead are set to spring the cold plate slightly, thus causing the radius of curvature of the new leaf to be reduced sufficiently to give the desired amount of space at the center between the leaves. In many cases leaves come from the furnace which are not straight edgewise. These may be placed in a horizontal position in front of the keys and straightened with one stroke of the crosshead.



End Elevation of Spring Forming Machine Showing the Counterweight Levers

This machine possesses a number of advantages, including simplicity and rapidity of operation as well as the uniformity of the work turned out. It does not require a high temperature in order to form the leaf and there is little danger of overheating the steel. This machine was developed by J. W. Riley, foreman blacksmith at the Sayre, Pa., shops of the Lehigh Valley.

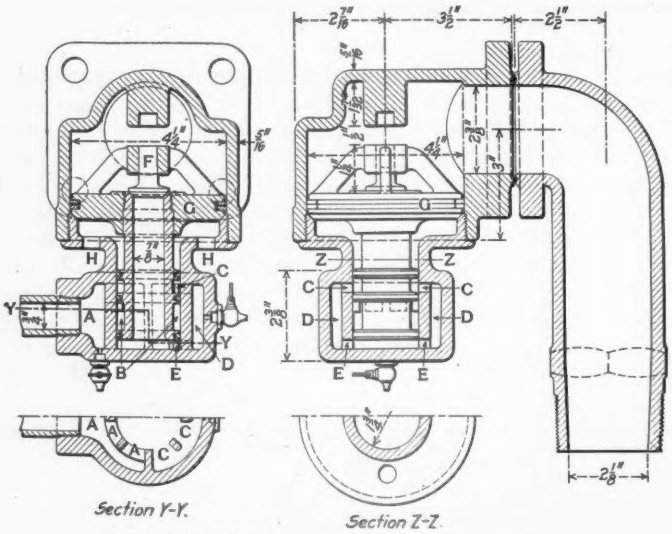
AUTOMATIC DRIFTING VALVE

A drifting valve designed for use with superheater locomotives by means of which live steam is automatically admitted to the cylinders in small quantities when the locomotive is drifting, has been developed on the Minneapolis, St. Paul & Sault Ste. Marie. It has been used with considerable success on the Soo line's large superheater locomotives and patents have now been secured.

As shown in the drawing the valve is designed to replace the ordinary steam chest relief valve which it somewhat resembles in appearance. It consists of a two-part casing within which operates a piston valve with a hollow ring-packed stem. A ¾ in. extra heavy pipe from the steam turret in the cab is connected to the casing and admits steam to chamber *A*. A valve is provided in the cab to shut off the supply of steam to this pipe if desired, but in practice the valve is open when the engine leaves the roundhouse and closed when the engine reaches the cinder pit. Through ports in the inner well of chamber *A* steam is admitted to the annular space *B* surrounding the hollow stem of the piston valve *G*. So long as there is pressure in the cylinder and steam chest the piston valve remains seated in the position shown in the drawing. When the throttle is closed and the engine is drifting, as soon as a vacuum forms atmospheric pressure acting upward against piston valve through the ports *H* in the casing raises the piston ½ in. which is the limit of its travel. This movement places the annular space *B* in communication with ports *C* through which steam from

chamber *A* passes into chamber *D* and thence through ports *E* to the hollow stem of the piston. The check valve *F* is raised from its seat and steam passes directly into the steam chest.

As soon as the engine stops or for any reason a slight pressure is formed in the cylinder the piston valve is forced downward to its seat, thus cutting off communication between the annular space around the hollow stem and chamber *D*. This valve has been found to greatly assist in the proper lubrication of cylinders where superheated steam is used.

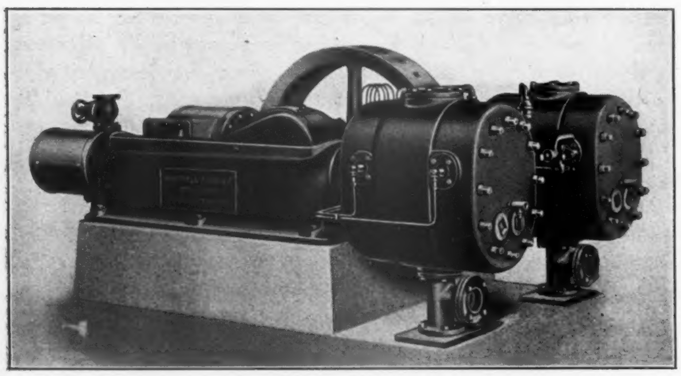


Drifting Valve for Superheater Locomotives

CONDENSER VACUUM PUMP

The modern power house equipment invariably includes a condenser plant, the efficiency of which depends upon the degree of vacuum within the condensing apparatus. For maintaining this vacuum and for general service in other lines where a high degree of vacuum is desired, the Ingersoll-Rand Company, 11 Broadway, New York, has recently introduced a complete line of steam and power-driven, duplex type vacuum pumps.

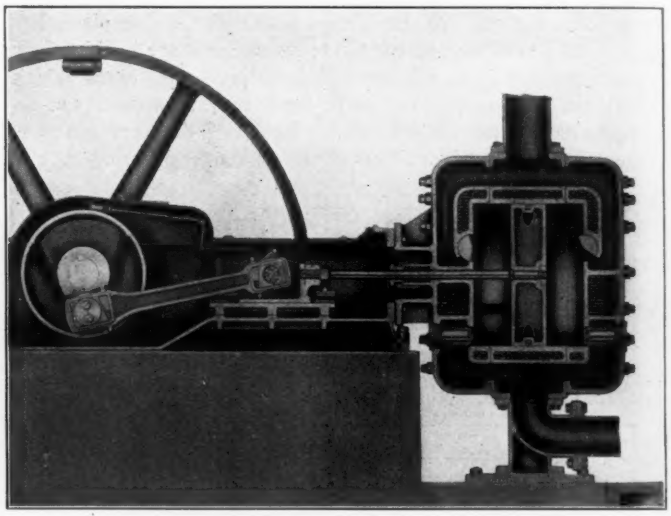
In general the design of these machines follows that of the Imperial air compressors manufactured by the same company. The intake valves are of the Corliss type, so placed in the cylinder head that the clearance is exceptionally low. This is a desirable feature in that the air trapped in the clearance spaces at discharge pressure will not reach such a volume, upon being expanded to intake pressure, as to greatly limit the pressure reduction which may be obtained. The action of the valve is quick and positive and is independent of the cylinder and intake pressures; the pressures within and without the cylinder are as nearly equal as possible. The intake ports are large and direct, which together with the water jacketing of the valves tends to cool the intake gases.



Steam-Driven Duplex Vacuum Pump

The discharge valves, which are of the direct lift poppet type, are placed in the bottom of the cylinder heads so that any entrained moisture or water is immediately discharged, a feature that tends to insure safety in handling moist or even saturated vapor. Clearance at the point of discharge has been reduced by making the valve partially fill the port in the cylinder head. The discharge passages are also water jacketed. Both cylinder and heads are completely water jacketed, which is an essential feature in the design of vacuum pumps, as the high ratios of compression tend to create high discharge pressures unless the heat is removed in the cylinder. Tie bolts pass from head to head and hold cylinder and heads tightly assembled.

The running gear, including the main frame with its enclosed reciprocating parts, the crank shaft, connecting rod, crosshead, valve gear and wheel on both belt and steam-driven machines are of the same design as used on Imperial air compressors. Lubrication is obtained by the bath system, providing automatic flood lubrication. By the removal of covers from the casing the enclosed parts are readily accessible. The Imperial vacuum pump occupies less floor space than machines of similar capacity of the straight line type, due to its duplex construction and to the fact that its speed of operation is higher. It is possible, should requirements fall temporarily below that for which the equipment was originally installed, to remove one connecting rod and discontinue the operation of one-half of the machine, while the other half operates at its rated speed and hence its utmost efficiency, displacing, however, one-half the vapor the entire machine is capable of handling.



Section Through Cylinder of Vacuum Pump

The machines are built in capacities from 798 to 7,048 cu. ft. per minute both for atmospheric and low pressure (5 lb.) discharge. It is claimed that they may be operated practically without attention and the maintenance of a vacuum within ½ in. of the barometric vacuum is guaranteed.

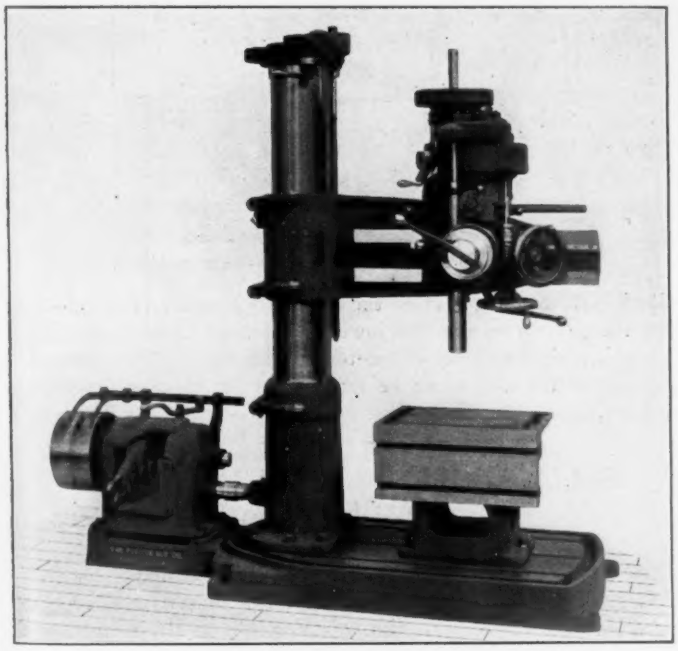
Iron Industry in Belgium.—Recent reports state that in the Liege district of Belgium only 6,800 men are employed in the iron industry out of a total of 14,700 in normal times. The Cockerill works are employing 5,200 in the blast furnaces, rolling mills and forge departments. Two small furnaces are in blast, yielding about 100 tons daily. In the Charleroi district the Providence works have one furnace in blast with a daily output of 150 tons. A revival of the steel industry is said to be only possible if Luxemburg ores can be obtained by a reduction of the high freight rates. Available raw materials are becoming scarcer and the industry may be brought to a total standstill.—*The Iron Age.*

HIGH SPEED RADIAL DRILL

A new design of radial drilling and tapping machine has been developed by the Fosdick Machine Tool Company, Cincinnati, which is known as the High Speed Manufacturing Radial, and is built in two sizes having 2-ft. and 2-ft. 6 in. arms, respectively. It is especially intended to meet the demand for a high-speed, durable machine, capable of handling a great variety of work in shops where unskilled labor is employed.

In general appearance these machines show a marked resemblance to the heavy duty radials built by the same company, and, in fact, the oil channel base and table, the double tubular column and the speed box are identical in both designs. The material used for the various parts has been carefully selected. The bushings are of special phosphor bronze, and gears under severe duty are of steel forgings, hardened where necessary. Where the speed is high or the duty light, cast iron or bronze of extra wide face and course pitch, are used. The spindle and principal driving shafts are of hammered steel, and the column, spindle and arm elevating thrusts are taken on ball bearings. The column and shafting are all finished by grinding.

These machines have a range of forty-eight rates of drilling, correct for 3/16-in. carbon to 2½-in. high speed drills in either iron or steel, and for boring up to five inches, all with but one speed at the pulley. A mental plate on the arm girdle, for high speed drilling, corresponds to the indexes on the head and on the



High-Speed Radial Drilling and Tapping Machine

speed box. Thorough tests have been made at the works with high speed drills up to 2½ in. in diameter in machinery steel and in cast iron, showing the pulling power to be far in excess of what will ever be required. For example, a 1-in. high speed drill was driven through a very hard cast iron slab two inches thick, in 7 4/5 seconds, or at a rate of 15.4 in. per minute; the speed being 550 r. p. m., and the feed .028 in. per revolution. The 2½-in. drill was successfully driven through 1½ in. of machinery steel at various rates, ranging from 137 r. p. m. with .007 in. feed, to 49 r. p. m. with a feed of 0.28 in. per revolution.

The 2-ft. machine will drill to the center of a 48-in. circle at the base, which has a working surface of 26 in. by 31 in. The 2 ft. 6 in. machine drills to the center of a 60-in. circle, and has a base working surface of 28 in. by 36 in. Other principal dimensions common to both machines are: base to spindle, 51 in.; spindle traverse, 12 in.; least diameter of spindle, 1 9/16 in.; spindle bore, Morse Taper No. 4. Tilting, swinging or round tables of the builder's standard types can be supplied. The net weight of the machines are 2,900 lb. and 3,200 lb., respectively.

As on heavy duty radials, the interchangeable drive has been adopted. The cone driven machine may be changed to speed box drive, or vice versa, or a constant or variable speed motor may be added at any time after purchase without the necessity of a special base, special speed box or special shafts or gears in the machine.

SMOKEBOX BLOWER FITTING

The illustration shows a locomotive blower fitting which is provided with a flange for direct attachment to the side of the smokebox. It is provided with three pipe connections,

Smokebox Blower Fitting

the inside connection leading to the blower nozzle, the right angle connection to the blower pipe in the cab, and the other to the roundhouse blower connection. A check valve, readily accessible through the cap shown in the illustration, automatically closes the roundhouse blower connection when the engine blower is in operation. It raises when the roundhouse blower is in operation and allows steam to pass into the smokebox. All passages are made for 1¼ in. pipe. It is manufactured by the Barco Brass & Joint Company, Chicago.

BORING TOOL HOLDERS

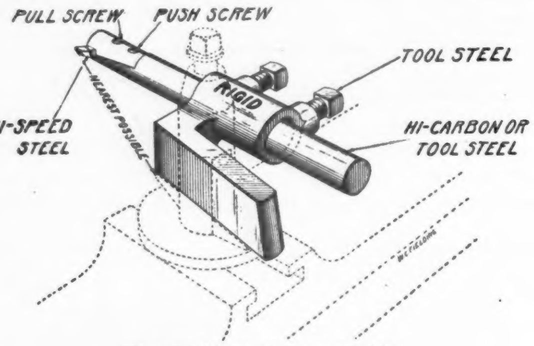
The boring tools illustrated herewith were recently placed on the market by the Rigid Tool Holder Company, Baltimore, Md. The tools consist mainly of a special lathe boring bar, in ten sizes, four types of holders therefor to meet various conditions, a special cutting off tool and internal and external thread tools.

The boring bar and two styles of holders are shown in the illustrations. The bar is made in diameters ranging from ½ in. to 2¼ in., and is fitted with a special cutter clamp which conforms to the normal exterior surface of the bar. This is held in place by means of two screws, the one nearest the end being threaded into the body of the bar and acting in tension, while the other is threaded into the clamp and acts as a set screw against the bar body. It has a leverage of 5½ to 1 against the cutter, which it securely clamps in position.

The tool post holder is a simple one-piece holder which has an angular opening between the shank and the barrel through which the bar passes. This enables the shank to be passed through the tool post until its front edge is supported by the

tool post wedge. The angle of the barrel also brings the cutter on a line directly in front of the wedge. The barrel is fitted with a bearing for the bar at each end, the latter being rigidly secured by two tool steel set screws.

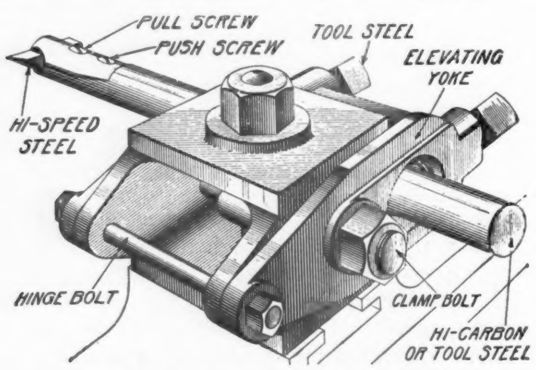
The adjustable boring tool is designed for general application and fits practically any lathe from 12-in. swing up. It replaces the ordinary tool post, and its broad base and heavy



The Rigid Tool Post Holder

construction is intended to give it exceptional rigidity. The swiveling elevating yoke may be clamped in any desired position between elevations varying approximately from 1 7/16 in. to 2⅛ in. Large key-ways cut with this tool have parallel sides where small cutters are used, because the tool may be elevated instead of revolving the work for succeeding cuts.

A double reversible holder is made which is a single piece of steel and very rigid. It is provided with two parallel holes or barrels, in either of which the tool may be clamped by set screws.

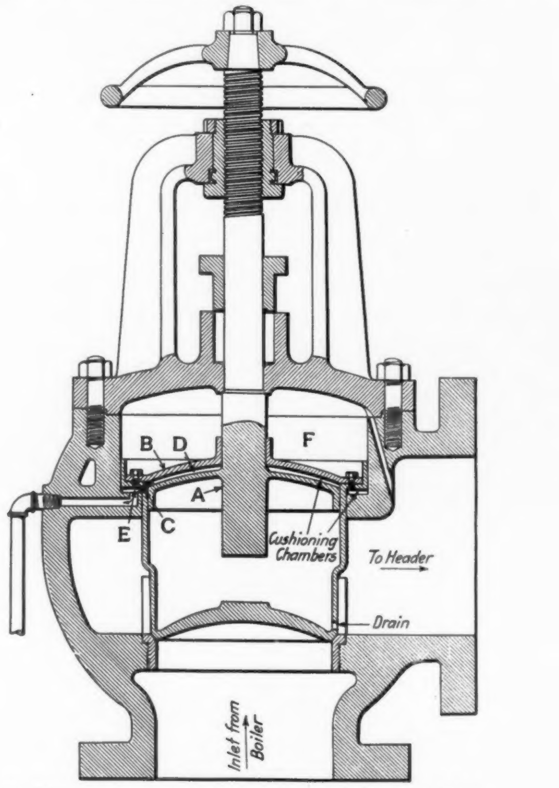


Double Reversible Tool Holder

These holes are so offset from the horizontal center line of the piece that by reversing it end for end and vertically a selection of four heights is available varying by eighths of an inch. The single reversible holder is a special tool, and reverses vertically only, giving but two heights of the tool.

AUTOMATIC NON-RETURN VALVE

The Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has placed on the market an automatic double-cushioned non-return valve for steam boilers. It is placed in the connection from each boiler to the main steam line to prevent back flow from the steam line when the pressure in the boiler is lower than that of the steam line. This automatic feature will protect the boiler in case of accident, such as the bursting of a tube, and will act as a safety stop to prevent steam from being turned into cold boilers. As the pressure in the boiler accumulates the main valve *B* will be raised and steam will be permitted to flow into the header. The chamber *F* serves as a cushioning chamber for the valve in its upward movement, and the chambers *D* and *E* cushion the valve in closing, these chambers being open to the steam pressure and connected through the valve by the passage *C*. By this construction hammering or chattering of the valve is eliminated. There is only one moving part to the entire valve, and that is the piston, *B*, which, as shown, is substantially guided in the body of the valve. The pipe at the left of the valve, extending out from the valve body, connects with a globe valve at some convenient position for testing the automatic service feature of the piston *B*. By



Golden-Anderson Automatic Non-Return Valve

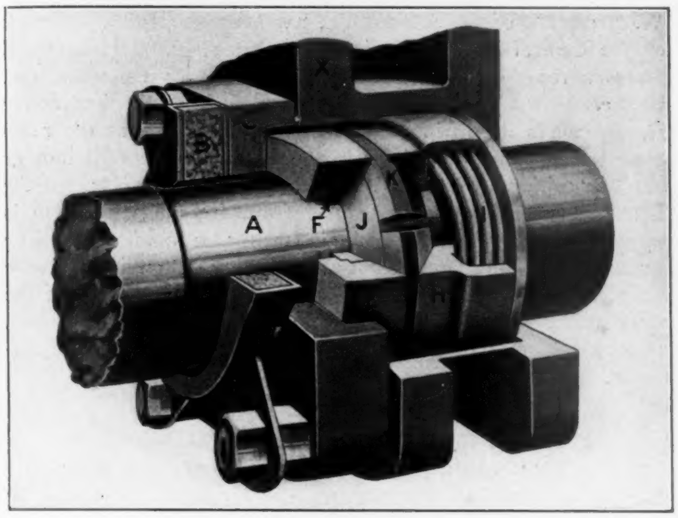
allowing steam to flow from the chambers *E* and *D* through this pipe the pressure from the lower cushioning chambers will be relieved, and the valve will automatically close. By means of the spindle the valve can be maintained in its closed position by hand.

SULLIVAN PISTON AND VALVE STEM PACKING

The process of applying packing to the piston and valve rods of locomotives does not present very much difficulty. The packing must be of a material that will not melt at the temperature of the steam, and will still be soft enough not to injure the rod. If this packing is bored out to an exact fit on the rod it will be tight. As the engine continues in service, however, the ring will become worn. A packing is thus desirable that will permit of continued wear until the packing rings are worn out. A packing ring that is cut square across the ring is believed to be preferable to that which is cut tangentially, as in the latter case the short ends are liable to become broken, thus permitting blows. Where the square cut ring is used there must be a clearance between the segments of each ring, and in order to make the packing tight two rings must be used, having the parting of their segments staggered. These rings will wear until the ends of the segments come in contact, when the ends should be filed to give the proper clearance. Another feature that is desirable is to have the packing rings maintain a constant bearing on the rods so that the ring will wear evenly throughout its bearing surface.

To meet these conditions the Jerome-Edwards Metallic Packing Company, Chicago, has placed on the market the improved

Sullivan piston and valve stem packing. In the illustration, *A* is the piston rod; *B*, the swab cup; *C*, the gland; *E*, the vibrating cup; *F*, the brass ring; *H*, a combined spring case and follower; *I*, the spring; *J*, the cone packing ring with a double bevel; *K*, the second packing ring; and *X*, the stuffing box. From this construction it will be seen that the spring *I* presses the packing ring *K* against the packing ring *J* (with the double bevel),

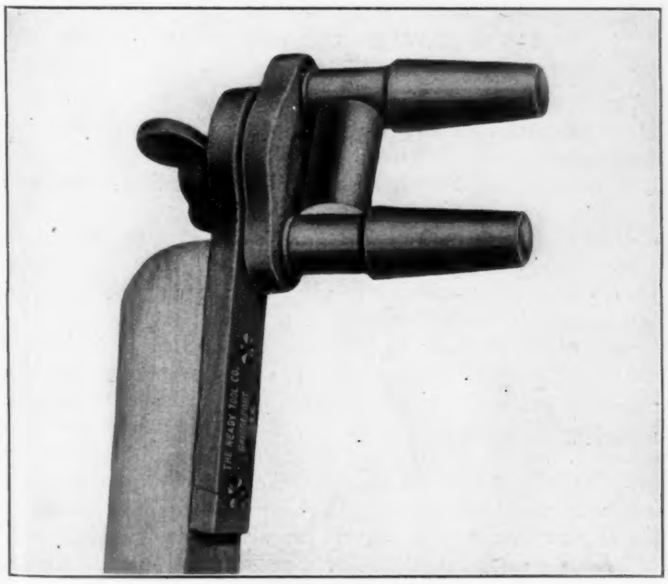


Construction of Sullivan Packing

forcing it onto the rod and at the same time against the vibrating cup *E*, which, being beveled, also forces it against the rod. With this construction steam leaks between the rod and the packing ring, or between the outside of the packing ring and the inside of the vibrating cup, are eliminated; in addition, the double bevel on the cone ring, *J*, tends to keep it central and the wear will thus be uniform.

SAFETY BELT STICK

A belt shifter, which is not only designed to save time, but to provide an absolutely safe means of shifting belts or throwing them on and off pulleys in motion, has been designed by



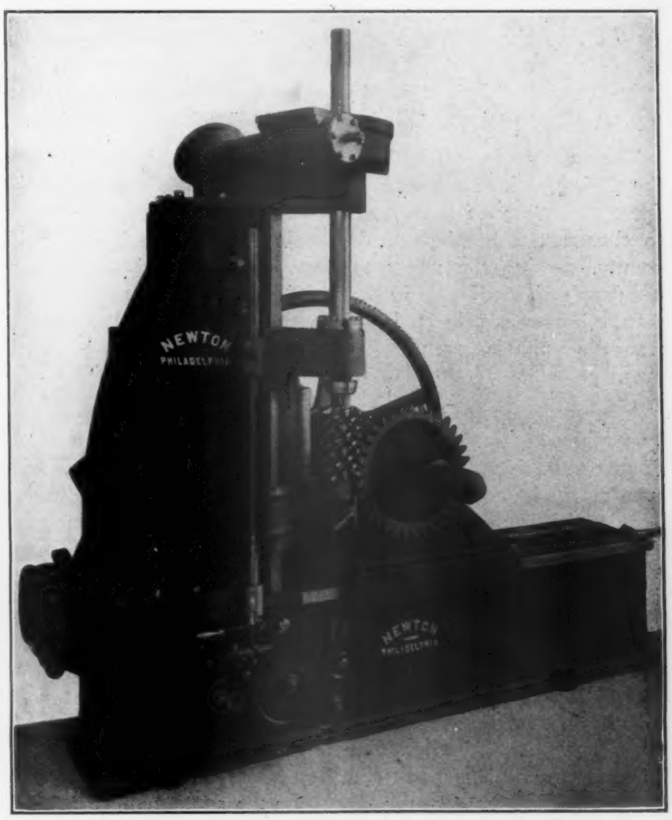
Swivel Roller Belt Shifter

the Ready Tool Company, Bridgeport, Conn. The device consists of a piece which is bolted to the regulation pole, to which is secured a swivel fork attachment. There are three rollers attached to the swivel plate, two of which are at right angles to the pole and are tapered. The third roller is located between the base of the other two and has its axis at right angles to them. It is intended to reduce the friction at the edge of the belt so that there is no possibility of the belt catching or sticking. The tapered rollers, between which the belt is placed, effect a tendency at all times for the belt to slide onto the pulley and away from the shifter. This is said to practically overcome the possibility of accident.

WORM WHEEL CUTTING MACHINE

The accompanying photograph shows a new worm-wheel cutting or generating machine, which has recently been developed by the Newton Machine Tool Works, Inc., Philadelphia, Pa., the cutting being done by either fly cutters or a taper hob. The cutter or hob has the form of a tap and is set so that the distance between its axis and the axis of the wheel is the same as that between the worm and wheel, and its angle to the plane of wheel is the same as that at which the worm actually runs. These measurements remain unchanged during the entire process of cutting.

Contrary to the practice generally followed, by which the teeth of the wheel are gradually cut deeper by feeding the cutter radially toward the wheel center, the cutter in this process is fed along its axis at a tangent to the circumference of the wheel, thus first cutting with the tapered end into the solid metal. The teeth of the wheel become gradually deeper as the increasing diameter of the cutter is fed into the work, the teeth being finished by the full end of the cutter as it passes through the work.



Tangential Feed Worm Wheel Cutting Machine

A large worm wheel having an outside diameter of 47½ in., a face 5½ in. wide and 92 teeth, triple lead and 2 diametral pitch, was put on this machine in 10 hours.

NEWS DEPARTMENT

Fire destroyed the coach and paint shop, a storeroom and several passenger coaches and freight cars of the Texas & Pacific at Marshall, Texas, on October 1.

The ocean-going ferry, Henry M. Flagler, carrying freight cars between Key West and Havana, is being worked to its full capacity, and officers of the Florida East Coast say that the facilities will soon be increased by the addition of another boat. It is proposed to build a vessel with a capacity of 38 cars. The Henry M. Flagler carries 28 cars.

One of the 50 electric locomotives being delivered by the General Electric Company to the Chicago, Milwaukee & St. Paul for use on the line between Harlowton, Mont., and Avery, Idaho, was placed on exhibition this week at the Union Station in Chicago. These locomotives are to be put in service sometime in November. The locomotives weigh 260 tons each, have 8 pairs of driving wheels, are 112 ft. long over all and are designed for operation with direct current at 3,000 volts.

On Saturday, November 6, the Business Men's Association of Deposit, N. Y., will celebrate, with a parade and speeches, the eightieth anniversary of the Erie. On November 7, 1835, the first ground was broken for the Erie Railroad at Deposit, N. Y. At the time that this construction work was begun the president of the company, James G. King, made the prediction that fully 200,000 tons of freight would be transported over the railroad a year. Last year the Erie handled 42,874,315 tons of freight.

The Wisconsin conservation commission has received from the Chicago, Milwaukee & St. Paul an appeal for protection from the colony of beaver which have taken it upon themselves to construct a number of dams along Bear Creek in Oneida county, causing the water to back up and flood the railroad company's right of way in the vicinity of Merrill and Goodnow. As the beaver is protected by law, the railroad could not kill or trap the animals, even though their dams are causing washouts.

A press despatch October 3 from Imlay, Nev., reports damage by earthquake shocks for a hundred miles along the line of the Southern Pacific. Several water tanks toppled from their high supports and one at Lovelock crushed the end of a dwelling. People fled from their homes in night clothing at many places. Slow orders were issued to all trains when the third shock was felt at 11 o'clock on the night of the third. At Golconda, Nev., a piece of track sank five inches. All the towns named are between Sparks and Battle Mountain.

John P. Dohoney, investigator of accidents, has made his report to the Pennsylvania Public Service Commission on the accident in a tunnel on the Philadelphia & Reading, at Phoenixville, Pa., September 28, when nine workmen were killed and nine others injured. The work train, on which these men were employed, had just entered the tunnel, on the southbound track, and had stopped; when a southbound passenger train, running on the northbound track, and moving at about ten miles an hour, ran into the men, who were walking along the track and, as it appears, struck more than one-third of the gang of fifty. The principal explanation given is that the conductor of the work train had given proper notice or instructions to the foreman and the workmen before entering the tunnel; but the state inspector says that this notice, if heard at all, was misunderstood, and that a written order should have been given to the foreman, explaining the proposed movement. The workmen were all foreigners, mostly Italian. They had been engaged for two weeks in the work of widening the tunnel.

BROWNELL'S AUTOMATIC STOP

A mechanical-trip automatic train stop, invented by George W. Brownell, of St. Albans, Vt., has been tried on a sidetrack of the Central Vermont Railway at that place. Mr. Brownell places a ramp on the ties between the rails of the track and, by means of a sliding tripper, suspended from the locomotive frame, causes the lifting of a valve on the engine as the ramp is passed, applying the air-brakes. The ramp is moved into or out of position by a dog, turned by a shaft connected to the visual signal. To prevent trouble from freezing, the ramp is supported in a trough, which, in winter, contains salt. The air apparatus, on the locomotive, moves a piston in a double cylinder, so arranged as to exhaust, at first, only a part of the air necessary to make a service application, further reduction, as may be demanded, being provided for by suitable adjustments.

PANAMA CANAL BLOCKED FOR A MONTH

The landslide which blocked the Panama Canal at Gold Hill, September 20, has been followed by others, and it is announced this week that vessels cannot pass through before November 1.

At least 1,000,000 yards of earth must be removed. On Tuesday the steamer Finland from New York was waiting, with 300 passengers aboard, and another vessel of the same line was waiting on the Pacific side. Both these vessels have also large cargoes of freight. The quantity of freight in vessels waiting to pass through the canal is so great that it could not be transported over the Panama Railroad in less than a month. Colonel Chester Harding, engineer in charge of the canal, has recommended that tolls already paid by waiting vessels be refunded.

According to the Canal Record, on October 5, there were 83 vessels tied up in the canal. Of these 45 were on the Atlantic side with an aggregate of approximately 167,000 tons of cargo, and 38 were on the Pacific side with approximately 189,000 tons of cargo. A number of boats which had intended passing through the canal are taking their cargoes around via the Straights of Magellan.

TEXAS RAILWAYS URGE LAW AGAINST TRESPASSING

The Texas railways are conducting a campaign in the interest of adequate laws to prohibit trespassing. As a part of this campaign the Central Safety First Committee of the International & Great Northern has issued a bulletin calling attention to the large number of trespassers killed on the railways every year, and urging school teachers, employers of labor, ministers, parents and others to do everything in their power to educate those within their sphere of influence regarding the evils of trespassing. The circular states that during the last 13 years the International & Great Northern has carried on its trains nearly 20,000,000 passengers without killing or even maiming a single passenger in train accidents, "which proves that the International & Great Northern is a very safe road for passengers;" but that during the same period its trains killed or seriously injured over 500 people, while trespassing on its yards and along the right of way, "which proves that the I. & G. N., like other railways, is a very unsafe place to walk upon."

Vice-president W. A. Webb, of the Missouri, Kansas & Texas, has issued a similar circular to all employees of the operating department, in which he says that more lives would be saved by enforcing laws against trespassing than by providing steel cars, installing block signals and abolishing grade crossings.

CAR AND LOCOMOTIVE ORDERS IN OCTOBER

During the month of October orders for locomotives, freight cars and passengers cars were reported as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	280	21,339	16
Foreign	...	.....	..
Total	280	21,339	16

Among the more important orders for locomotives were the following: Pittsburgh & Lake Erie, 10 Mikado type locomotives, American Locomotive Company; Central of Georgia, 8 Mikado and 4 Pacific type locomotives, Lima Locomotive Corporation; Atchison, Topeka & Santa Fe, 30 Mikado type locomotives, Baldwin Locomotive Works; Philadelphia & Reading, 30 Mikado type locomotives, Baldwin Locomotive Works; Cincinnati, Indianapolis & Western, 42 locomotives, Lima Locomotive Corporation; Illinois Central, 47 Mikado type locomotives, Lima Locomotive Corporation, and 3 Santa Fe type locomotives, American Locomotive Company, and the Pennsylvania Railroad, 75 Mikado type locomotives, Baldwin Locomotive Works.

The largest order for freight cars reported during the month was, of course, that placed by the New York Central. As nearly as can be ascertained the order has been divided as follows: Haskell & Barker Car Company, 2,000 box cars; Pullman Company, 1,000 automobile cars; American Car & Foundry Company, 1,500 box cars, and the Standard Steel Car Company, 4,500 gondola cars, a total of 9,000 cars, these being in addition to orders placed in September and previously reported. Among other large orders were: Wheeling & Lake Erie, 750 gondola cars, Standard Steel Car Company, and 200 automobile cars, Western Steel Car & Foundry Company; Illinois Central, 1,000 refrigerator cars, American Car & Foundry Company; Central of Georgia, 500 freight cars, American Car & Foundry Company, and 500 box cars, Pullman Company; Norfolk & Western, 1,000 90-ton gondola cars, company shops; Chesapeake & Ohio, 1,000 gondola cars, Standard Steel Car Company; Western Maryland, 2,000 hopper cars, Pullman Company, and Philadelphia & Reading, 1,000 box cars, American Car & Foundry Company; 500 gondola cars, Standard Steel Car Company, and 1,000 hopper cars, Pressed Steel Car Company.

Of the 16 passenger cars noted in the table 14 were ordered by the Boston & Maine of the Pullman Company and the Laconia Car Company.

MEETINGS AND CONVENTIONS

The Central Railway Club.—At the next meeting of the Central Railway Club, which will be held in Buffalo on the evening of November 12, 1915, arrangements have been made for an informal complimentary dinner at Hotel Statler. This will be served at six o'clock, and will be followed by the regular meeting at eight o'clock. The paper of the evening will be on "Rubber: From Raw to Finished Product," and will be illustrated with moving pictures. Ladies are invited to both occasions.

Chilled Car Wheel Manufacturers.—At the annual meeting of the Association of Manufacturers of Chilled Car Wheels, held in New York on October 12, officers were re-elected as follows: President and treasurer, George W. Lyndon; vice-presidents, E. F. Carry and J. A. Kilpatrick; secretary, George F. Griffin; consulting engineer, F. K. Vial. The board of directors consists of E. F. Carry, J. A. Kilpatrick, W. S. Atwood, Chas. A. Lindstrom, F. K. Vial, A. G. Wellington, W. C. Arthurs, J. D. Rhodes, F. B. Cooley, A. J. Miller and Wm. F. Cutler.

June Mechanical Conventions.—A joint meeting of the executive committees of the Master Car Builders' Association, the American Railway Master Mechanics' Association and the Railway Supply Manufacturers' Association will be held at the Hotel Statler, Cleveland, Ohio, Monday, November 15, at 10 a. m. The object of the meeting will be to decide upon the dates for the June conventions, as well as the place of the meetings, and also to discuss other details of the joint work of these three associations. It is planned also to hold separate meetings of the executive committees of each one of the associations after the joint meeting. The meeting is being held at Cleveland because of the illness of President MacBain, of the Master Car Builders' Association, who expects, however, to be sufficiently recovered by November 15 to participate.

American Society of Mechanical Engineers.—The annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Societies' Building, 29 West Thirty-ninth Street, New York City, on December 8, 9, and 10, 1915. The railroad session will be held on the afternoon of Wednesday, December 8, and considerable effort has been put forth by the sub-committee on railroads to provide a program of general interest. Papers will be presented as follows: Operation of Parallel and Radial Axles of a Locomotive by a Single Set of Cylinders, by Anatole Mallet, and Four-Wheel Trucks for Passenger Cars, by Roy V. Wright, Managing Editor Railway Age Gazette, which is published elsewhere in this issue. It is also expected that a paper will be read on the six-wheel truck for passenger cars.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILROAD MASTER TINNERS, COPPERSMITHS AND PIPEFITTER' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth st., New York. Annual meeting, December 7-10, 1915, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago. Second Monday in month, except July and August, Lytton Building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMAN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick Building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Henry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., East Buffalo, N. Y.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Nov. 9	Rubber as Related to the War	A. D. Thornton	James Powell	St. Lambert, Que.
Central	Nov. 12	Rubber: From Raw to Finished Product.	.....	Harry D. Vought.	95 Liberty street, New York.
New England	Nov. 9	The Fuel Department—A Failure?	L. G. Plant	Wm. Cade, Jr	683 Atlantic avenue, Boston, Mass.
New York	Nov. 19	The Railroads and National Defense	Geo. D. Snyder	Harry D. Vought.	95 Liberty street, New York.
Pittsburgh	Nov. 26	Workingmen's Compensation	W. S. Diggs	J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Nov. 8	Election of Officers	.....	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Nov. 12	Pleasant Valleys and Rocky Mountains.	H. R. Leffingwell	B. W. Frauenthal.	Union Station, St. Louis, Mo.
South'n & S'w'rn	Nov. 18	Locomotive Inspection	Frank McManamy.	A. J. Merrill	Box 1205, Atlanta, Ga.
Western	....	.....	.....	Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.
Western Canada	....	.....	.....	Louis Kon	Box 1707, Winnipeg, Man.

PERSONALS

GENERAL

C. E. BROOKS, acting superintendent of motive power of the Grand Trunk Pacific, has been appointed superintendent of motive power, with office at Transcona, Man. He will also assume the duties of master car builder.

A. H. EAGER, superintendent of shops of the Canadian Northern at Winnipeg, Man., has been appointed assistant superintendent of rolling stock with headquarters at Winnipeg.

CLYDE C. ELMES has been appointed assistant superintendent of motive power and rolling equipment of the Philadelphia & Reading with headquarters at Reading, Pa. Mr. Elmes began railway work in 1903, at the Olean, N. Y., shops of the Pennsylvania Railroad, and after learning the machinists' trade he attended Purdue University. He subsequently returned to the Pennsylvania Railroad at Olean, as gang foreman, and later was promoted to roundhouse foreman. He then served as superintendent at Auburn, N. Y., of the New York, Auburn & Lansing, now the Central New York Southern, leaving that company to go to the Kansas City Southern as superintendent of construction of new shops at Shreveport, La., and on the completion of that work was transferred to Pittsburgh, Kan., as roundhouse foreman. He was subsequently promoted to chief inspector of new locomotives being built for that road. He was then consecutively general foreman at Ennis, Texas, of the Houston & Texas Central, acting master mechanic of the general shops of the Southern Pacific at Houston and master mechanic of the same shops with the duties of master car builder until his appointment as assistant division superintendent of the Texas & New Orleans. He then went to the Philadelphia & Reading and served consecutively as motive power inspector, road foreman of engines and as assistant engineer of motive power until his recent appointment as assistant superintendent of motive power and rolling equipment of the same road, as above noted.

C. C. Elmes

A. L. GRABURN, mechanical engineer of the Canadian Northern at Toronto, Ont., has been appointed assistant superintendent of rolling stock of the Eastern lines, with office at Toronto, Ont.

W. L. HAZZARD has been appointed supervisor of piece work, motive power department of the New York Central, with office at Grand Central Terminal, New York.

J. A. MITCHELL has been appointed general foreman of the National Transcontinental, in charge of the motive power department at Transcona, Man.

IRWIN A. SEIDERS has been appointed superintendent of motive power and rolling equipment of the Philadelphia & Reading, with headquarters at Reading, Pa. Mr. Seiders was born on October 23, 1864, at Tamaqua, Pa., and was educated in the public schools. He began railway work on January 18, 1882, as a laborer on the Philadelphia & Reading, and the same year became machinist helper. He later served as station hand and then as brakeman until September, 1888, when he was appointed locomotive fireman, and two years later became an engineman. In April, 1907, he was promoted to road foreman of engines, remaining in that position until December, 1914, when he was appointed fuel inspector, and now becomes superintendent of motive power and rolling equipment on the same road, as above noted. Mr. Seiders' entire railway service has been with the Philadelphia & Reading.

GORDON SPROULE has been appointed acting engineer of tests of the Canadian Pacific at Montreal, Que., succeeding E. B. Tilt, resigned.

SAMUEL G. THOMSON, superintendent of motive power and roling equipment of the Philadelphia & Reading at Reading, Pa., has resigned.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. E. GOULD has been appointed master mechanic of the Charlotte Harbor & Northern with office at Arcadia, Fla., succeeding W. H. McAmis, resigned to accept service elsewhere.

R. M. KINCAID, valuation engineer of maintenance of equipment of the Chicago & Eastern Illinois, has been appointed master mechanic of the Illinois and St. Louis divisions, with office at Villa Grove, Ill., succeeding F. Studer, resigned.

W. C. MOORE, master mechanic of the Ottawa division of the Canadian Northern at Trenton, Ont., has been appointed master mechanic of the Toronto district, with headquarters at Trenton, Ont.

CAR DEPARTMENT

H. W. ANDREW, coach yard foreman of the Canadian Northern at Winnipeg, Man., has been appointed general car foreman at that point, succeeding A. McCowan, promoted.

E. ELEY, division car foreman of the Canadian Pacific at North Bay, Ont., has been apointed master car builder, eastern lines, with office at Montreal, Que., succeeding F. B. Zercher.

E. HACKING, heretofore car foreman of the Grand Trunk Pacific at Prince George, B. C., has been appointed general car foreman, to look after the Grand Trunk Pacific car equipment turned out of the Transcona shops, now operated by the National Transcontinental.

J. L. HODGSON, formerly master car builder, Grand Trunk Pacific, has been appointed general car foreman, National Transcontinental, at Transcona, Man., and has charge of the car department at divisional points, Transcona to Fort William inclusive.

J. E. JOHNSTON, night coach foreman of the Canadian Northern at Winnipeg, Man., has been appointed coach yard foreman at that point, succeeding H. W. Andrew, promoted.

A. McCOWAN, general car foreman of the Canadian Northern at Winnipeg, Man., has been appointed supervisor of car works at the same place.

C. A. MUNRO has been appointed car foreman of the Grand Trunk Pacific at Prince George, B. C., succeeding E. Hacking, promoted.

EDWARD J. THILL has been appointed supervisor of piece work, rolling stock department of the New York Central, with office at Grand Central Terminal, New York City.

SHOP AND ENGINE HOUSE

H. DARBY has been appointed acting locomotive foreman of the Grand Trunk Pacific at Biggar, Sask., succeeding A. McTavish, promoted.

A. T. HANNAH, formerly assistant foreman of the Canadian Northern at Saskatoon, Sask., has been appointed locomotive foreman at Humboldt, Sask., succeeding W. B. Steeves, transferred to Saskatoon, Sask.

C. R. HENING, roundhouse foreman of the Michigan Central at Kensington, Ill., has been appointed general foreman of the machine shop at Michigan City, Ind.

L. B. JONES has been appointed general foreman in charge of the mechanical department of the Macon, Dublin & Savannah at Macon, Ga.

FRED A. RAUBER has been appointed night roundhouse foreman of the Atchison, Topeka & Santa Fe at Dodge City, Kan.

A. MCTAVISH, formerly locomotive foreman of the Grand Trunk Pacific at Biggar, Sask., has been appointed locomotive inspector to look after Grand Trunk Pacific motive power equipment turned out of the Transcona shops by the National Transcontinental.

PURCHASING AND STOREKEEPING

FRANK P. DUGAN has been appointed division storekeeper of the Illinois Central at Vicksburg, Miss., succeeding Eugene D. Meissonnier, resigned.

C. E. LEPARD, heretofore employed in the office of the locomotive foreman of the Canadian Northern at Regina, Sask., has been appointed division storekeeper at that city, succeeding J. Butterfield, enlisted for active military service.

WILLIAM S. MOREHEAD has been appointed division storekeeper of the Illinois Central at McComb, Miss., succeeding Frank P. Dugan.

W. D. STEWART, heretofore foreman of the erecting shop, Intercolonial Railway, Moncton, N. B., has been appointed assistant to the geenral storekeeper of the Canadian Government Railways, with office for the present at Transcona, Man.

WILLIAM D. STOKES has been appointed assistant general storekeeper of the Illinois Central, with headquarters at Memphis, Tenn., succeeding William S. Morehead, transferred.

NEW SHOPS

THE LAKE ERIE & WESTERN.—This company is constructing a concrete machine shop, 40 ft. by 120 ft., at Tipton, Ind., to replace the building destroyed by fire some time ago.

THE ILLINOIS CENTRAL.—This company will build a steel structure, 176 ft. by 1,200 ft., equipped for repairing wooden cars at Nonconnah, Tenn. The contract for the construction work has not yet been let, but about one thousand tons of steel have been ordered from the American Bridge Company.

THE INTERNATIONAL & GREAT NORTHERN.—This company has purchased 108 acres of land, five miles out of San Antonio, Tex., as a site for shops, yards and roundhouses. It is stated that approximately $500,000 will be expended. The plans for the buildings have been drawn and work will be started soon. O. H. Crittenden, chief engineer, Houston, Tex.

THE SEABOARD AIR LINE.—This company has given a contract to the Christian Construction Company, Durham, N. C., to build additional shop facilities at Portsmouth, Va. The work will include a machine and erecting shop, blacksmith shop, flue shop, engine carpenter and paint shop, also a substation. The work will be pushed to completion, and it is expected that it will be finished early in 1916. There is considerable steel work involved in the construction of the main buildings, and hy-rib walls or similar material will be used in the machine and erecting shop.

SUPPLY TRADE NOTES

Stanley H. Smith has been appointed district sales manager of the Pennsylvania and Maryland Steel Companies at Chicago, to succeed Robert E. Belknap, transferred to New York City.

S. H. Smith

Mr. Smith was born at Toronto, Ont., on August 4, 1885. He entered the service of the Pennsylvania Steel Company in February, 1904, as a shop apprentice. After spending two and one-half years in various mills of the company, he served as an outside inspector for the frog and switch department. Later he joined the sales force of the company at Steelton, Pa., and from there was transferred to Cleveland, Ohio, where he represented the Pennsylvania and Maryland Steel Companies for two and one-half years. Next he took a position in Chicago, where he became first assistant to Robert E. Belknap, recently transferred to New York.

The Hilles & Jones Company, Wilmington, Del., has moved its Pittsburgh office to larger quarters in the Oliver building, Room 235.

The Edison Storage Battery Company, Orange, N. J., has removed its Cleveland office to the David Whitney Building, Detroit, Mich.

J. R. McAllister has been elected a director of the Electric Storage Battery Company, Philadelphia, Pa., succeeding Rudolph Ellis, deceased.

The Sprague Electric Works of the General Electric Company has opened a sales office in the Provident Bank building, Cincinnati, Ohio, in charge of Frank H. Hill as manager.

W. E. Hardy, who has been in charge of the sales of the mechanical rubber goods division of the Diamond Rubber Company and the B. F. Goodrich Company, has been appointed sales manager of the Boston Belting Company, Boston, Mass.

Reports are current that the Baldwin Locomotive Works will sell to the Midvale Steel & Ordnance Company the buildings and land at Eddystone, Pa., now under lease to the Remington Arms Company, which was recently acquired by the Midvale interests.

The George E. Molleson Company, sales agents for iron and steel products and railway supplies and New York representatives for the Tyler Tube & Pipe Company, Washington, Pa., has moved its offices from 50 Church street to 30 Church street, New York.

W. Hoyt Weber & Co., New York, have completed arrangements with the MacDonald Car Buffer, Limited, of Montreal and Pittsburgh, whereby they will represent the latter in the eastern part of the United States. The members of the firm are W. Hoyt Weber and Horatio S. Schroeder The firm has offices in the Vanderbilt Concourse building.

The New York Air Brake Company has been awarded a medal of honor for its exhibit at the Panama-Pacific International Exposition. By a more recent decision of the superior jury of awards, the final official authority, the company has also

been awarded a grand prize, the highest award, for its "PS" electro-pneumatic equipment.

The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, has been awarded two prizes by the International Jury of Awards at the Panama-Pacific International Exhibition. They are the grand prize from the department of agriculture for press machines and a gold medal from the department of machinery for forcing presses and equipment.

Robert E. Belknap, district sales manager of the Pennsylvania Steel Company at Chicago, has been transferred to the New York office as district sales manager, succeeding R. W. Gillespie, recently appointed general manager of sales. Thomas Blagden, Jr., has been appointed assistant sales manager at New York, and R. W. Reid, who has been assistant sales manager in the New York district, has been appointed district sales manager at Steelton, Pa.

Walter H. Evans, of Chicago, has been appointed western railroad department manager of the U. S. Metal & Manufacturing Company, New York. Mr. Evans was recently manager of the motor gear department of the Edgar Allen American Manganese Steel Company, Chicago, and previous to his connection with this company was connected with several electric and steam roads in the capacity of master mechanic and superintendent of motive power. Mr. Evans will make his headquarters in the McCormick Building, Chicago.

H. A. Varney, general sales manager of the National Boiler Washing Company, Chicago, has resigned to become manager of the railroad department of the Smith-Totman Company with offices in the People's Gas building, Chicago. Mr. Varney was born at Spencer, Iowa, on September 9, 1877, and was educated at the public schools of his native city and at the Iowa Agricultural College. He came into the railway supply field in 1906 as a member of the construction force of the W. L. Miller Heating Company. He joined the sales force of the National Boiler Washington Company in 1909, and was later promoted to the position with that company which he now resigns.

A. E. Ostrander has been appointed mechanical engineer of the American Car & Foundry Company, and is succeeded as assistant mechanical engineer by H. C. Lunger, who was formerly chief estimator. W. H. Selden, formerly assistant chief estimator, succeeds Mr. Lunger. Mr. Ostrander, who succeeds John McE. Ames, who recently resigned as mechanical engineer to go into other business, began railway service on the New York, New Haven & Hartford, serving in several different capacities in various departments on that road. Later he was employed in the engineering office of Cornelius Vanderbilt, leaving there to accept a position with the Standard Steel Car Company. He entered the service of the American Car & Foundry Company in 1903, and has been with that company continuously since that time.

The Westinghouse Electric & Manufacturing Company announces the following awards received at the Panama-Pacific Exposition: The grand prize on the 4,000 h.p., 650-volt d.c. double unit Pennsylvania electric locomotive mounted on a turntable under the dome of the Transportation Palace; the medal of honor on alternating current and direct current industrial motor and control apparatus; on precision instruments; on Le Blanc condensers; on motor-generator sets for moving picture machines and on high voltage oil switches; the gold medal on a number of different classes of apparatus, among which are steam turbines, alternating and direct current generators, alternating and direct current railway motors, transformers, rectifiers, starting, lighting and ignition systems, switchboards and accessories, and mining locomotives. The Westinghouse Electric & Manufacturing Company was also awarded the gold medal for the most complete and attractive installation in the Palace of Transportation. It also received a number of silver and bronze medals.

CATALOGS

Screw Cutting Tools.—The Wells Brothers Company, Division of the Greenfield Tap & Die Corporation, Greenfield, Mass., has recently issued catalog 34 relative to the company's line of screw cutting tools and machinery. The booklet contains a large number of new devices and improvements on old ones and like its predecessors stands in the front rank as a reference book in this line.

Storage Battery Cars.—Bulletins No. 30, 31, 32 and 34 issued by the Railway Storage Battery Car Co., New York, illustrate and describe a number of city and interurban cars equipped with storage batteries for supplying the driving power. One of the bulletins gives some comparative costs between standard overhead construction and the equipment necessary when Edison batteries are used.

Sand-Blast Apparatus.—The Mott Sand Blast Manufacturing Company, New York, has issued four folders dealing with the following sand-blast apparatus which it manufactures: the Mott direct-pressure sand-blast machine, hose type; the Mott sand-blast tumbling barrel; revolving table and cabinet, type G; the Mott type P. V. S. double sand-blast tumbling barrel and Mott sand-blast accessories.

Flue Tools.—Gustav Wiedeke & Co., Dayton, Ohio, have recently issued a 96-page catalog, descriptive of the Ideal flue tools, manufactured by the company. The booklet describes and illustrates the line of Wiedeke Ideal tube expanders, cutters and accessories. Each tool mentioned is described, and in connection with the description there are given specifications, price lists and detailed views of the tool and its parts.

Railroad Specialties.—The Q & C Company, New York, has issued an elaborate catalog, illustrated in colors, describing its various products, including the Bonzano joint, the Vaughn rail anchor, tie plates and other track appliances, Ajax vestibule diaphragms, snow flangers and the Ross-Schofield system of circulation for locomotive boilers. The various features are illustrated in detail separately and in actual service.

Locomotive Cranes.—The Browning Company, Cleveland, Ohio, has recently issued two rather unusual folders relative to the use of the company's cranes in railway service. One is entitled, "How to Be Reasonable About Handling Scrap Iron and Other Materials," and the other bears the name, "Railroad Construction With Locomotive Cranes." Each folder contains four illustrations, showing Browning cranes at work.

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Sworn to and subscribed before Harry E. French, Notary Public for Kings County, N. Y. (No. 15), whose certificate is filed with the County Clerk of New York (No. 13), and whose commission expires March 30, 1916, on September 29, 1915.